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ABSTRACT

Suggestions for school shops are presented in three general areas--(1) planning, (2) layouts, and (3) tools and equipment. Within the planning area, two types of shop programs are discussed--(1) industrial arts education, and (2) trade and industrial education. Layouts and floor plans are provided for the following shops: auto mechanics, building trades, commercial art, cosmetology, drafting, general electrical, general machine, metal trades, mill cabinet, print, radio and television, and sheet metal. Suggested shop equipment and tools are discussed under the following headings--(1) automotive, (2) building trades, and (3) drafting. A glossary of terms is included. (FS)

ED037003

SUGGESTED

SCHOOL SHOPS

LAYOUTS

JUSTIFICATIONS

EQUIPMENT

FOR TRADE AND INDUSTRIAL EDUCATION PROGRAMS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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FOREWORD

Effective shop instruction which meets trade and industrial objectives depends, to a large extent, upon adequate equipment, tools and materials, and upon efficient shop organization and management. Regardless of how well a shop building has been planned architecturally, school officials frequently request assistance from persons with experience--both in industry and shop instruction--in laying out and equipping shops which meet accepted industrial standards and yet are suitable for instructional purposes.

Special attention should be given to the justification for implementing certain features into the construction of new shops to maintain supervision and discipline to the highest degree. The suggestions contained in this bulletin represent the consensus of experienced industrial teachers and supervisors of trade and industrial programs as a special problem in a course, Shop and Classroom Organization and Management, consisting of the following class members:

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ACKNOWLEDGEMENTS

In preparing this bulletin, material from a variety of sources was used. Suggestions, illustrations, and examples on school shop layouts and equipment--too numerous to mention specifically--were secured from recognized authorities. Many of the more pertinent suggestions have been used in the bulletin.

Special acknowledgement is given the University of Texas, Division of Extension, Industrial Education Department and the Texas Education Agency, Industrial Education Service, Austin, Texas.

JUSTIFICATION

Justification for Suggested Features and Facilities

It should be noted by persons responsible for developing school shops that the small extra cost for the additional features and facilities will bring many rewarding returns in a much improved training program.

The prime factors determining the success of a shop program are: First, the quality and interest of the teacher; second, the adequacy as to size and layout of the facility; third, the quantity and quality of tools and equipment; and last, the need in the area for the craft and the interest of the community.

The recommendations on shop sizes and layouts as set forth in this handbook are vital in promoting safety, effiency of operation and supervision, morale of the class, and hence a better learning situation.

Lockers for personal belongings aid in the personal cleanliness of the student while preparing to attend other classes. Storage lockers allow project storage and prevent theft and horseplay. One toilet for students and one for instructor will eliminate the necessity of absence from shop area during class periods. Separate wash and rest rooms for each shop reduce loitering and situations which give rise to disciplinary action.

Elimination of solid partitions or construction of transparent partitions aid the instructor in supervision and observation, and reduce discipline situations; also promote better housekeeping.

Lavatories or wash basins should be in the general shop area to insure ease of access and better supervision.

The recommendations on storage space in showing either transparent partitions or doors flush with shop area wall also aid in supervision and elimination of discipline problems.

The philosophy as set forth for these shop layouts improves training, safety, and maintains orderly conduct.

The instructor can see everyone in the shop at all times and give personal instruction to the student who needs help.

This eliminates normally valid reasons for the student leaving the shop.

It also develops a more desirable learning situation.

With the proper location of storage rooms, ease and facility of handling materials and supplies will result; and again hazards and discipline problems will be minimized. All of these factors will aid greatly in developing an incentive for learning.

The two prime factors governing the size of the shop are: the number of students per class, and the type of shop. All shops should be rectangular; and, if possible, the length should be twice the width. A square or nearly square facility is always undesirable, as it is extremely difficult to arrange machines and equipment so as to make an efficient use of floor space.

PLANNING SCHOOL SHOPS

Preliminary Information

Two Types of Shop Programs

Persons responsible for planning school shop buildings and selecting and laying out machines and equipment within such shops should clearly understand the overall objectives and standards of the two different types of shop programs which may be operated in the schools of this state: namely, Industrial Arts Education and Trade and Industrial Education.

Industrial Arts Education

Industrial Arts programs aim to develop in the student knowledge and appreciation of industrial processes and materials, and to provide opportunities to explore and develop shop skills on an avocational basis in a wide variety of industrial fields. Classes are scheduled for one school period daily. Shop machines and equipment, in general, are lighter and less expensive than similar types of machines required in industry.

Trade and Industrial Education

Trade and Industrial Education in our public schools is designed primarily for students in their last two years of high school, or in junior colleges students who have already selected a vocational objective and who wish to prepare for full-time employment in their chosen industrial field after graduation. Shop facilities--including building, machines, tools, and materials should be of the

type used in the industry of the surrounding area, and the processes or operations taught should closely parallel accepted industrial practices. Classes are scheduled for three consecutive hours each school day and courses are designed for two school years of preparatory training. Frequently, such shops are also used for evening extension training of employed industrial workers in the community.

Advisory Committees

Trade and industrial training of any type should be based upon the needs of the community and industrial area. It is a cooperative undertaking to be shared by the school and community, and for this reason, advice and counsel of persons who are close to the industrial life of the community should be sought by local schools in the selecting, planning, and equipping of school shops.

The organization of advisory committees, composed of key representatives of industrial and lay groups, should be the first step in the planning or expansion of industrial vocational programs. Copies of this publication should be provided for advisory groups and architects in developing the final plan for a shop program.

Justification for Suggested Features and Facilities

It should be noted by persons responsible for developing school shops that the small extra cost for the additional features and facilities will bring many rewarding returns in a much improved training program.

Consultative Assistance

For schools which desire additional advice and assistance in planning and equipping trade and industrial shops, free consultative

services may be obtained from staff members of the following office:

J. W. Lewis
State Supervisor, Trade and Industrial Education
Mississippi State Department of Education
Box 771
Jackson, Mississippi

Location of Shop Buildings

1. Shop buildings in which industrial vocational courses are offered should be compatible with the environment in which they are located, and should present an appearance that will attract young people and adults. The general appearance of the shops and the immediate surroundings will to a great extent reflect the attitude of the students and quality of instruction provided.
2. Industrial vocational shops should, in most instances, be located in a building separate from one in which regular classroom activities are carried on. This is especially true of shops which are normally a source of noise during the instructional period. Such shops include the following types: Automotive, aircraft, building trades, printing, metal working, radio, and electrical.
3. Shops in which there is normally little noise associated with instruction may, if it is desired, be located in buildings containing regular classrooms. Such shops include the following types: Drafting, cosmetology, commercial art, commercial sewing, and photography.
4. In school plants in which it is not feasible to house industrial vocational shops in a separate building, shop "wings" or building extensions will isolate shop noises from the rest of the school plant to a certain extent.

5. Although it is desirable to house shops in separate buildings, they should be so situated as to be an integral part of the total school plant and not be located off the school campus.
6. "Heavy" shops--those requiring heavy equipment and considerable unobstructed floor space--should be located on ground floors, and preferably, in one-story buildings. They should be located so as to be readily accessible to trucks and other vehicles, especially those which depend upon the public to a certain extent for instructional jobs or projects.
7. "Light" shops--such as those listed in paragraph 3 above--may be located upstairs if necessary.
8. Building units housing vocational shops or classes should be connected by covered walkways.
9. Shops of all types should be located away from playgrounds.
10. Shop buildings and individual shops should be identified with appropriate signs.

The Shop Area

1. Shops requiring several motor-driven machines, work benches, and an open area for assembling jobs and projects, should contain an area dependent upon program objective and type of program, usually 3,000 square feet.
2. Other shops requiring little or no machinery or bulky equipment should contain at least 2,500 square feet of floor space.
3. Shops should contain two entrances, a principal entrance for use of students and a service entrance.
4. Outside doors should open outward from the shop. Doors to auxiliary rooms should open into the shop.

5. The ideal shape of the shop area is rectangular. There should be no protruding walls or partitions to obstruct the view of any part of the shop. If partitions are necessary, they should be of transparent material.
6. Shops under the supervision of one instructor should be in one area and not divided between two or more rooms.
7. No equipment should be placed around the tool room and in open areas near entrances and exits so as to restrict the passage of students, flow of materials, and for safety.
8. An open assembly area, free of equipment, should be provided for shops in which miscellaneous parts of large instructional projects will be assembled.
9. The shop area should contain adequate drinking fountains and one or more sinks with hot and cold water, and should not be located in rest room area, but should be in an open area easily accessible to students and in view of instructor to eliminate discipline problems.
10. All shops should be wired with 3 phase, 110 volt, 4 wire system with distribution for power and lights to all parts of shop area.

Auxiliary Facilities

1. In general type shops, it is frequently desirable to provide an area of approximately 400 square feet within the shop proper where students may assemble for group instruction, to plan jobs and projects, take tests, do research, and engage in other similar activities. Such areas are generally called "planning" areas.
2. Planning areas should be provided with adequate tables and chairs,

one or more drawing tables, a blackboard, and should be located near the main entrance of the shop.

3. Where partitions within the shop are desired--as in the case of tool rooms--a wooden partition or wainscot not exceeding four feet in height is recommended. Wire mesh to any desired height may be used above the partition. In welding areas, booths should be provided with solid partitions.
4. Ample storage rooms are required of each shop, in which large amounts of materials and supplies are consumed in the course of instruction.
5. Storage rooms should be flush with the shop wall and not extend into the shop area. Storage rooms to house heavy or bulky material should be provided with outside doors for receiving truck deliveries.
6. Passageways to auxiliary rooms, tool rooms, toilets, drinking fountains, and the like, should be four feet wide, free of equipment, and should be outlined by stripes painted on the shop floor.
7. Washrooms and toilet facilities should be in the shop area and should be adequate to prevent congestion at the end of the class periods.
8. Separate, dust-proof finishing rooms, provided with exhaust fans, are recommended for shops in which any type of painting and finishing is done.
9. If two or more shops are contained within a building unit, it is desirable that an adjacent classroom be equipped for day-time

moving picture projection.

10. If a separate projection room is not feasible, day time projection of films and slides can be done successfully through use of a daylight projection box described in the bulletin, Instructional Aids Cabinet.
11. Shops with a planning area which includes an instructor's desk, filing cabinet, and instructional material case do not generally require a separate office for the instructor.
12. Whenever feasible, display windows or cases should be included in hallways for exhibiting projects made by shop students.

General Location of Shop Equipment

1. Machines having the same or similar functions should be grouped.
2. In general type shops, which include instruction in several units of a family of trades, the equipment related to each unit should be localized. Certain utility machines (grinders, drill presses, etc.) should be duplicated in each of the units requiring them.
3. Machines should be located so as to provide adequate space for the operator and instructor, and also have ample clearance between adjacent machines for safe handling of materials.
4. Generally, very heavy machines should be located as near the service door as feasible.
5. All machines, other than light or semi-portable types, should be level and mounted on concrete bases.
6. Two or more machines normally used in a sequential order—such as sheet metal and woodworking machines—should be located in their logical order so as to minimize unnecessary handling of materials.

7. Machines used primarily for roughing out or cutting stock to size should be located near the material storage room door in such a manner that they can receive the materials with maximum ease.
8. Machines should be located and positioned so as to receive the maximum size of material that will be used in instruction.
9. The most-used machines should be located so as to take advantage of the best natural light. North light is preferable.
10. For mechanical shops, several small movable work benches to accommodate one or two students each are preferable to one long built-in bench running along a wall. However, built-in benches, used in addition to small movable benches, are frequently used in shops to an advantage. It is preferable that storage shelves not be placed under work benches.
11. Movable work benches or tables, if used near a row of windows, should be placed at right angles to the wall and not parallel to it. At least four feet of clearance should be provided between benches.
12. Machines having several attachments and requiring tools for setting up and operating should be provided with small movable service tables.
13. Individual lockers for students' personal belongings and incompleted shop projects should be provided inside the shop area.
14. All shops should contain a large bulletin board (approximately 3' x 4') near the principal entrance, tool room, or planning area.
15. A space near the service entrance should be provided for waste cans, and discarded scrap material. Large scrap bins should be

provided outside of shops in which large amounts of waste materials are discarded.

16. Storage space should be provided for acetylene and oxygen bottles outside the shop building.

Locating Specific Items of Equipment

Vocational shops and their equipment layouts should approximate that of industrial plants and shops to a large extent; however, there are several differences between teaching a trade and practicing a trade which have a direct bearing on shop layouts. Some of these are:

The degree of close supervision required in school shops to minimize the possibility of personal injury, damage to equipment, and discipline problems on the part of relatively inexperienced youth, is seldom required in industrial shops. This fact should have a great influence upon shop planning. Safeguards against injury to students' person and health are of paramount importance in school shops and consequently must carry greater emphasis than is found in the average industrial shop.

Individual instruction and demonstration to small groups in school shops necessitate wider spacing of items of equipment than is found in industrial plants.

School shops should contain only the equipment considered basic to, or typical of, the trade taught, and should not contain massive or specialized equipment (invariably expensive) which is employed in production and which usually requires large quantities of stock and materials. Specific items, and number and sizes of items of equipment for school shops should be

purchased only after an evaluation of their cost vs. instructional benefit has been made.

In planning the layout of any shop it is well to keep in mind several principles which are generally accepted by shop teachers as being ideal. While it is unlikely that all these principles can be incorporated into any one new or remodeled shop due to limitations of available floor space, window and entrance arrangement, and the like, the majority of them can be adhered to by persons planning any type of vocational shop.

1. Power hack saws and cut-off saws should be located near the stock storage room.
2. Tool and cutter grinders used for maintaining shop equipment should be located inside the tool room. If the operation of such a grinder is a major instructional unit, the machine should be located with other types of precision machines.
3. Lathes located near windows should be turned at an angle to the wall so as to permit light from the windows to fall along the length of the lathe bed and illuminate the head-stock.
4. Drill presses may be located with backs to a wall or post or in open areas back-to-back.
5. In general, drill presses and grinders should be of the pedestal (or floor) type and should not be mounted on benches or tables.
6. Pedestal grinders may be located against a wall or post or in a convenient place in an open area.
7. Utility sanders and grinders of appropriate type and size should be conveniently located to the unit to be served, but not in such a

position that flying grit and abrasive particles can damage nearby equipment.

8. All precision machines should be located in areas free from chance of accidental damage by air-borne grit, sand, or moisture.
9. Radial drills may be mounted with backs to a wall, but not in corners, unless ample clearance for arm swing is provided.
10. In locating metal shapers, ample safe clearance should be provided for the ram.
11. Forges, furnaces, and arc welding booths should be located near an outside wall and a cover with an exhaust is preferred.
12. Machinist vises should be installed so that they are on the right-hand side of a person working at an individual bench (or work station), and wood vises should be located on the left-hand side of work benches.

Safety Equipment

The majority of accidents of all types result from the misuse of ordinarily safe devices. Modern shop equipment is so designed as to make accidents almost impossible unless the operator is careless and violates well established rules of safety. School shops must also be designed to eliminate accidents.

School officials should provide for every type of protective device required for safe operation or use of equipment and shop facilities by students. Following are listed several important items of safety equipment which should be provided.

1. Every shop should be equipped with a fire extinguisher of adequate size, located near the principal entrance in a conspicuous place.

2. Every shop should be equipped with a FIRST AID KIT located in a conspicuous place.
3. Should the shop building harbor any hazardous zone, the area should be surrounded by a guard rail which is painted in accordance with recommended safety practices.
4. A safety zone should be painted around hazardous machines and equipment. Passageways may also be painted.
5. Switches on power-driven machines should be of the safety type and be located in such a position as to avoid accidental contact with passers-by.
6. The exhausts of all live internal combustion engines to be operated within the shop should be connected with outside exhaust ducts, preferably the underground type.
7. Adequate ventilations must be provided to remove any toxic gases or smoke liberated by furnaces, forges, engines, arc welding, etc. This does not apply to oxy-acetylene welding unless metals which produce toxic vapors are involved.
8. All electric motors on machines should be grounded.
9. All machines should be controlled by a master switch under lock and key.
10. All metal fixtures and furniture in electrical shops should be insulated. Metal-top work benches are not recommended.
11. All inflammable materials should be kept in metal containers in small quantities.
12. Hazardous machines, such as those having exposed gears or belt driven pulleys, for example, must be equipped with adequate guards for safe operation.

13. Large supplies of metal stock, lumber, and the like should be kept in a stock room and not openly accessible to students.
14. Metal containers should be provided for oily rags and waste.
15. Containers for waste materials should be conveniently located throughout the shop.
16. Clean goggles must be kept in a conspicuous place at any type of grinding machine, preferably near the control switch.
17. Drip pans or other devices should be provided for machines to prevent oil puddles on shop floors.
18. If cartridge fuses are used, fuse pliers of a non-conductive material should be readily available for handling them.
19. Fireproof electric fixtures should be used in spray rooms and storage rooms for paints and lacquers.
20. Posters or bulletins should be displayed prominently so that students are constantly reminded of safety practices and correct dress in shops.

Heating and Ventilation

1. It is highly desirable that the heating system of shops and related classrooms be independent of that of the main school plant.
2. The recommended heating system is the overhead fan-driven type.
3. Heating units should be of sufficient capacity to maintain automatically a shop temperature of 68°F., measured five feet from the floor.
4. The ventilating system should insure an adequate supply of outside air.

5. Shops in which dust, smoke, vapors or gases are common should be provided with mechanical exhaust systems.
6. Dust collecting systems should be provided each woodworking machine, such as planer, saw, and joiner.
7. All rooms or booths in which paints are sprayed, and in which arc welding is done, should be provided with forced exhaust systems.
8. Exhausts from all gasoline or diesel engines should be muffled and connected with an underground exhaust system.

Lighting

1. Windows should be located in shops so as to take advantage of indirect sunlight. Frosted or diffusing glass in windows on the south and west sides greatly reduce glare and shadows.
2. The total window area of shops should be from 20 to 25 percent of the floor space.
3. Natural lighting must be supplemented by artificial lighting for shop operation on dark days and evenings. Lighting systems should be designed to produce a uniform pattern of glare-and shadow-free illumination.
4. Recommended lighting levels at the point of work for various types of activities are given in the following table:

Activity	Foot Candles
Drafting; precision work at bench or machine.	.50-55
Ordinary machine or tool operation.	.40-45
Study and planning.	.30-35
Washrooms, store rooms.	.10-15

5. Indirect fluorescent lighting is generally considered the superior lighting system for the average school shop or classroom.

Indirect silver bowl incandescent lighting is considered an excellent system and is frequently preferred in shops where machines are operated at high speeds. Some persons object to the stroboscopic effect of fluorescent lighting. Fluorescent lighting is available that overcomes this effect.

6. Precision machines should be equipped with individual auxiliary lights.

Painting Shops and Equipment

More and more, industrial plants are employing scientifically selected colors in the painting of shops, machines, and auxiliary equipment. Years of research have been spent in determining the effects of illumination and color upon the productivity, accuracy, morale, and safety habits of industrial workers.

Students are prepared in school shops for employment in industrial plants, and for this reason, the environment of the school shop should duplicate as nearly as possible that of modern industrial shops.

It is much more economical to specify proper types and colors of paint in the building contracts for new shop buildings than to repaint improperly painted shops and equipment later in accordance with acceptable practices. In order to guide school shop planners in specifying suitable paints, the following recommendations are given:

1. Ceilings: Light colors with high reflective qualities are recommended for ceilings.
2. Walls: As a rule, light to medium colors, having a reflective

value of 50 to 60 per cent, are recommended for shop walls. So-called "restful" colors--such as green--are preferred by many shop teachers. Such a color should have the same general value (though not necessarily the same color) as that seen by the students at their various work stations. Colors to avoid are glaring whites and gloomy dark shades.

3. Machines:

(a) The body or non-operating parts of a machine should be painted in a receding color, such as gray-green, which has a relaxing effect upon the eye.

(b) The operating parts of a machine should be painted with a color, such as cream or buff, which stands out in contrast to the body of the machine and which focuses the attention of the operator upon the operation he is performing. This color should also be in contrast to and "spotlight" the materials being worked.

(c) Machine controls (levers, wheels, etc.) should be painted in a high-visibility color, such as yellow. Electric switch boxes on machines should be painted so as to stand out clearly from the rest of the machines. Starting buttons should be black and stop buttons should be red.

Shop Floors

1. The kind of floor selected for a school shop depends to a great extent upon the type and weight of equipment to be used and the amount of wear and abuse to which it normally will be subjected.

Floors in so-called "heavy" shops which must withstand considerable wear should be of concrete.

2. Unless concrete floors are necessary, wood or wood-on-concrete floors are preferred.

3. Shops in which no heavy equipment is required and in which cleanliness and attractive appearance are essential may have soft tile or linoleum-covered floors.

4. Floors recommended for various types of shops are given in the following table:

<u>Concrete</u>	
General machine	Automotive
General metal	Sheet metal
<u>Wood or wood-on-concrete</u>	
General electrical	Woodworking
Radio and television	Related classrooms
Printing	Offices
<u>Linoleum or soft tile</u>	
Cosmetology	Commercial art
Drafting	

Central Tool Rooms

A well arranged and efficiently managed tool room is essential to sound shop instruction. Some of the chief requisites of such a tool room are: (1) convenient location, (2) adequate space, (3) convenient and safe means of housing tools and equipment, and (4) an efficient system of checking tools to and from students. The following suggestions are intended to assist school officials and shop instructors in planning tool rooms which meet these requirements:

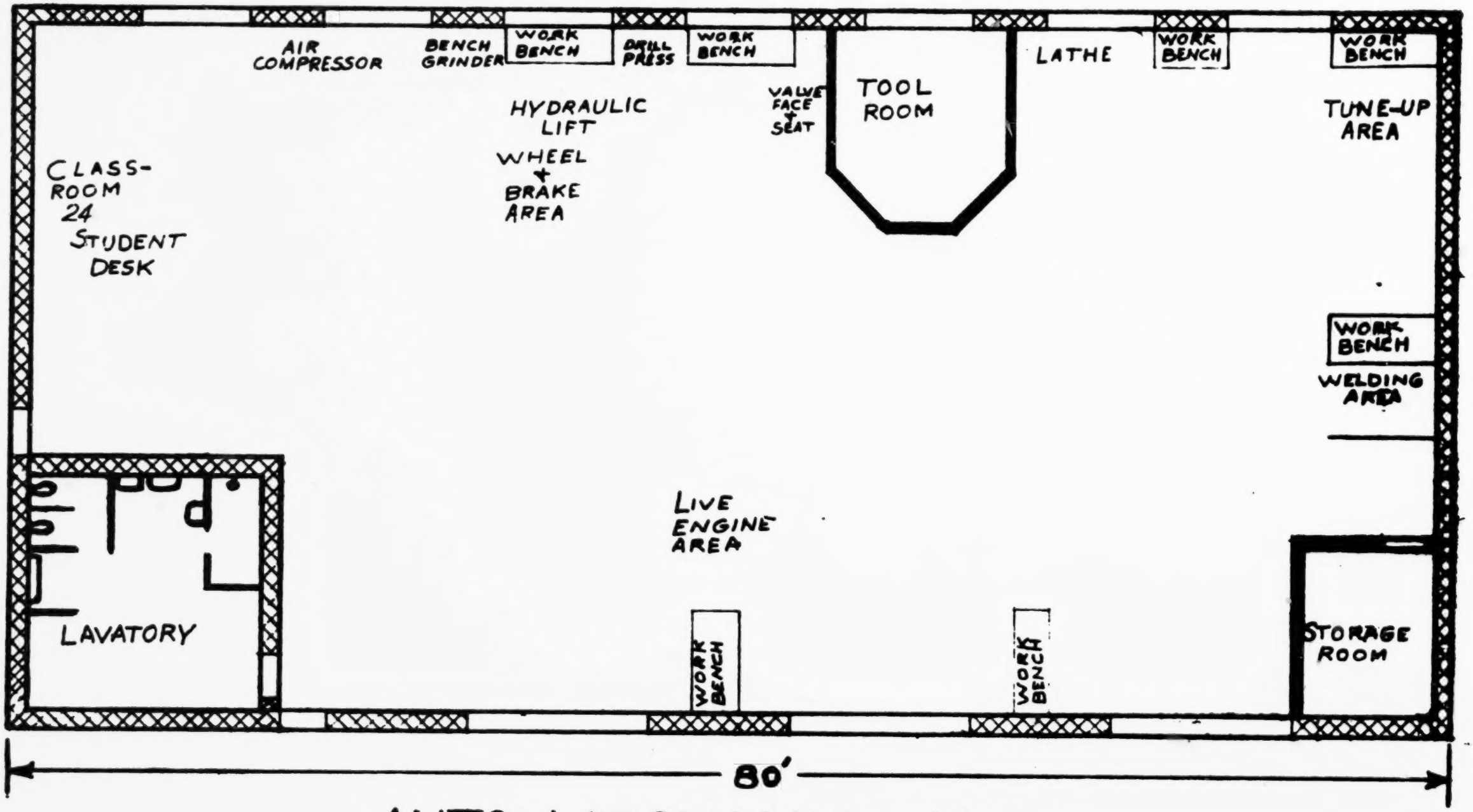
1. The tool room should be conveniently located within the shop area

so as to minimize the distance travelled to and from it. Two or more unobstructed passageways should lead to it, as a safety precaution.

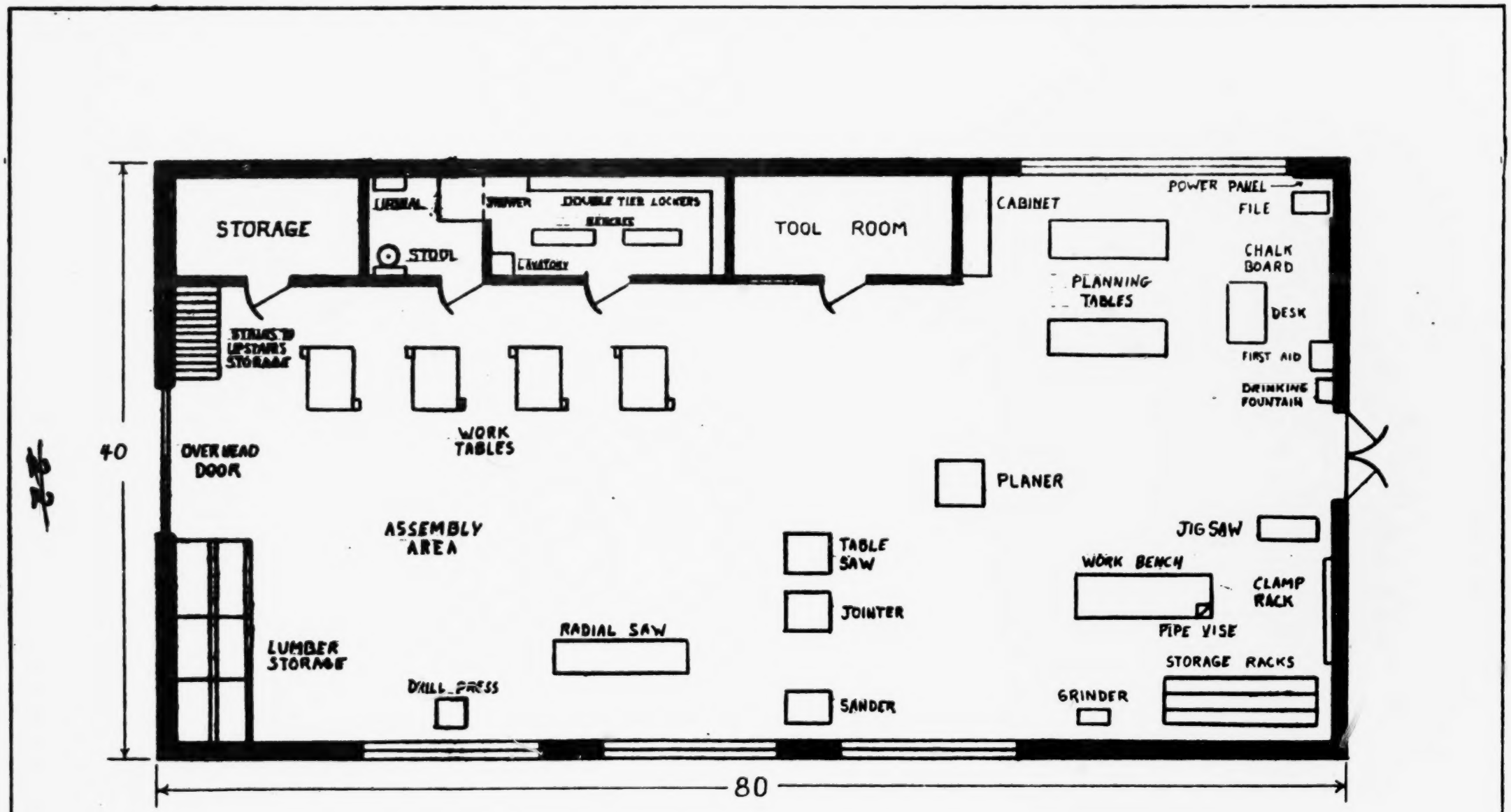
2. Two, and preferably three, sides of the tool room should be open so as to permit the instructor to see into it from various points within the shop.
3. The open sides of a tool room may consist of a four-foot wainscot or partition with burglar-proof wire mesh above to any desired height.
4. Like or similar tools should be grouped together with the most-used occupying the most convenient location.
5. Surplus tools and materials should be kept in a storage room and not in the tool room.
6. Expensive, precision tools and instruments should be kept in a locked cabinet or drawer.
7. Tool windows should contain a shelf of adequate size. A Dutch type door is frequently used to conserve wall space.
8. Tools used in groups for the operation of one machine or hand tools grouped as "kits" should be kept together in one container and issued on one check.
9. Hand tools and equipment should be mounted on wooden panels around the walls to a height of about 6 feet. Panels may be placed in the open area of the room, making them accessible from both sides.
10. Tools should be mounted on the panel in such a manner that they are securely held but not actually fastened.
11. Tools having several sizes, such as sockets, reamers, drills, and

the like should be mounted in progressive order with the sizes clearly indicated.

12. A small screw hook to hold tool checks should be placed immediately below or beside each tool on the rack or panel.
13. Silhouette panels, on which the outline of the tool is painted in a contrasting color is a popular method of mounting tools. It makes checking on missing tools a simple task. Carelessly built silhouette panels present an unsightly appearance. Nails and other makeshift devices for holding tools should not be used.
14. Another excellent manner of mounting tools is by use of small shelves, brackets, or blocks, in which holes or notches are cut to fit the contour of the tool.

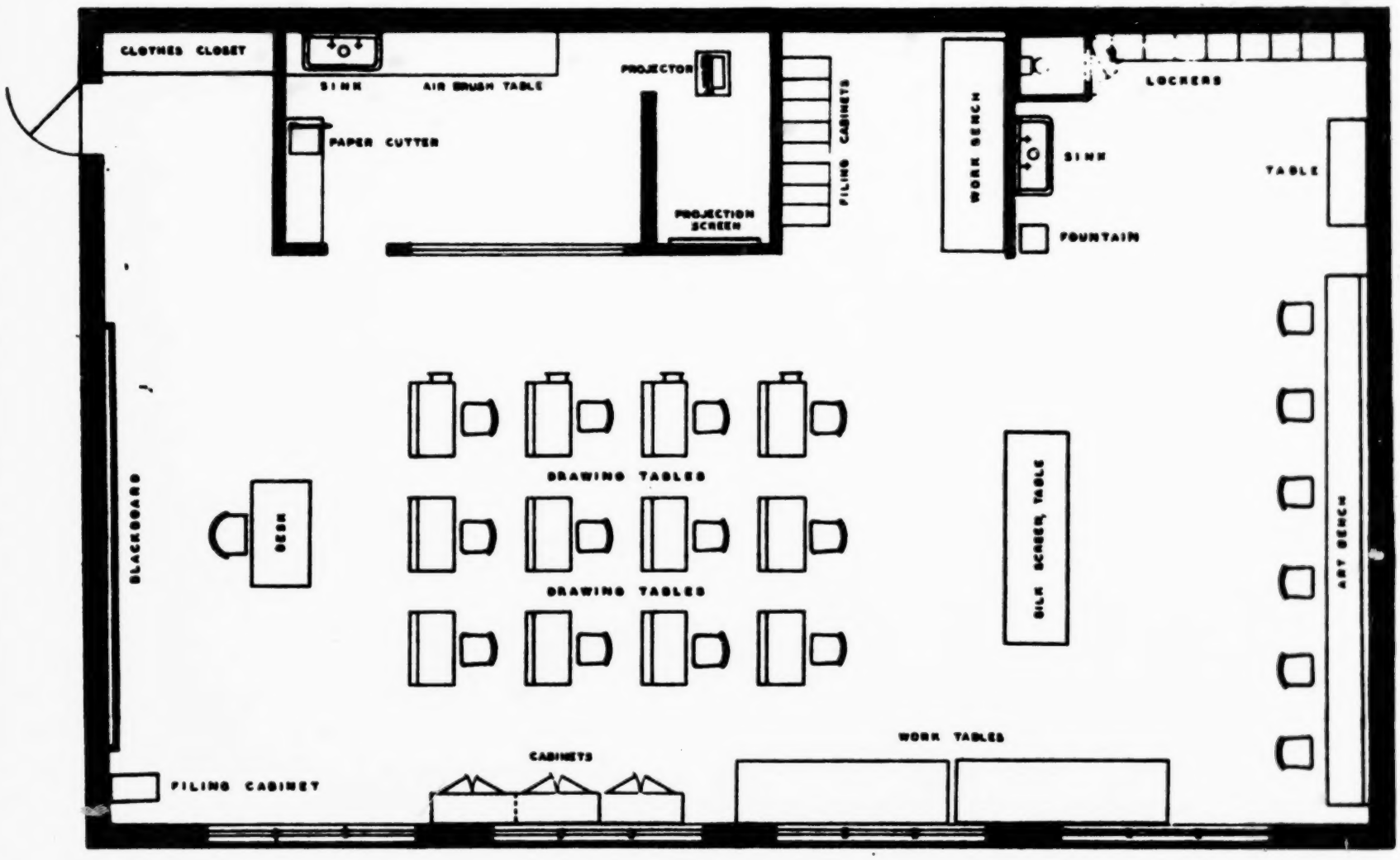


AUTO MECHANICS SHOP



BUILDING TRADES SHOP

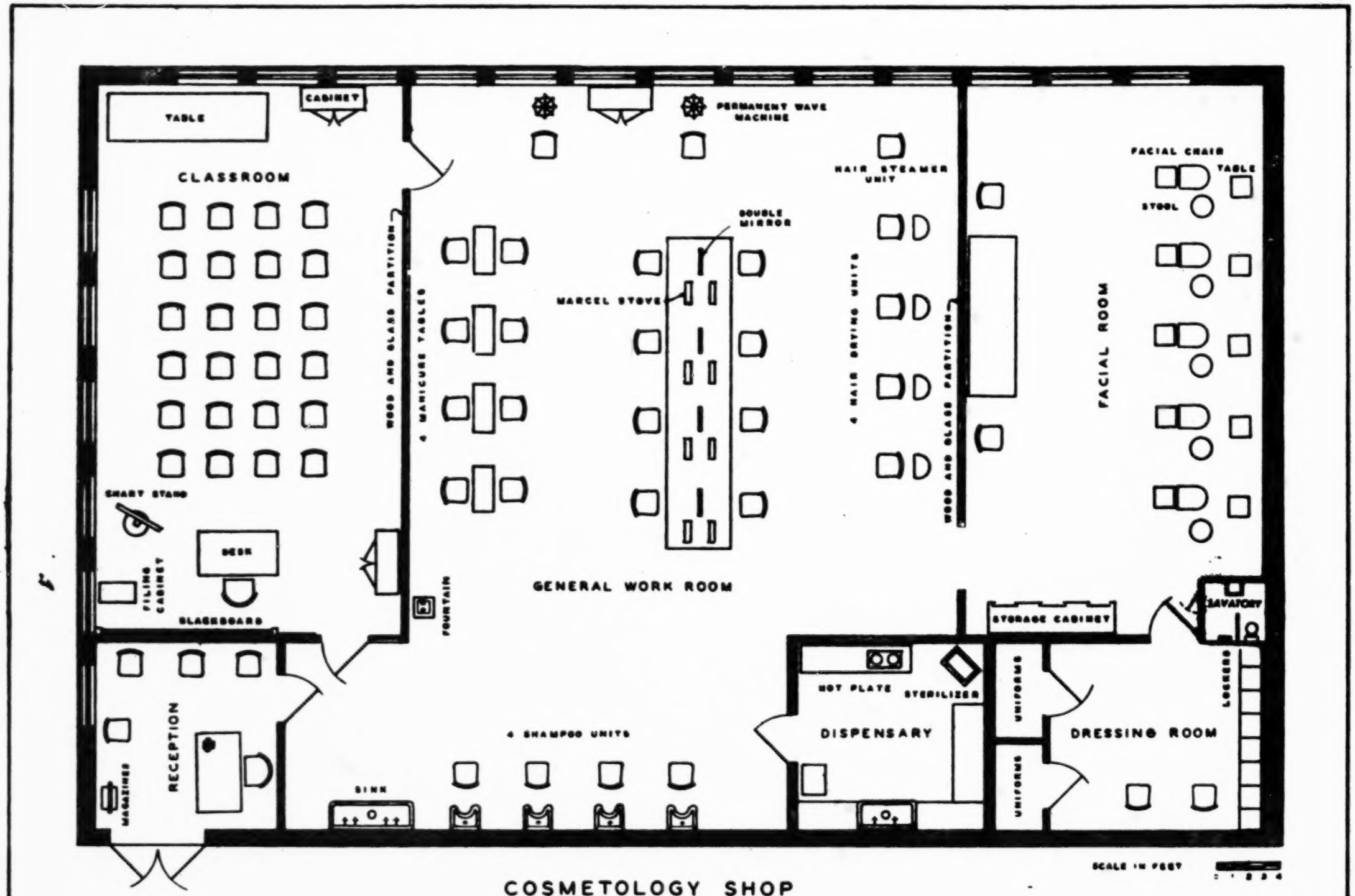
SCALE ~ $\frac{3}{32}$" = 1'



COMMERCIAL ART SHOP

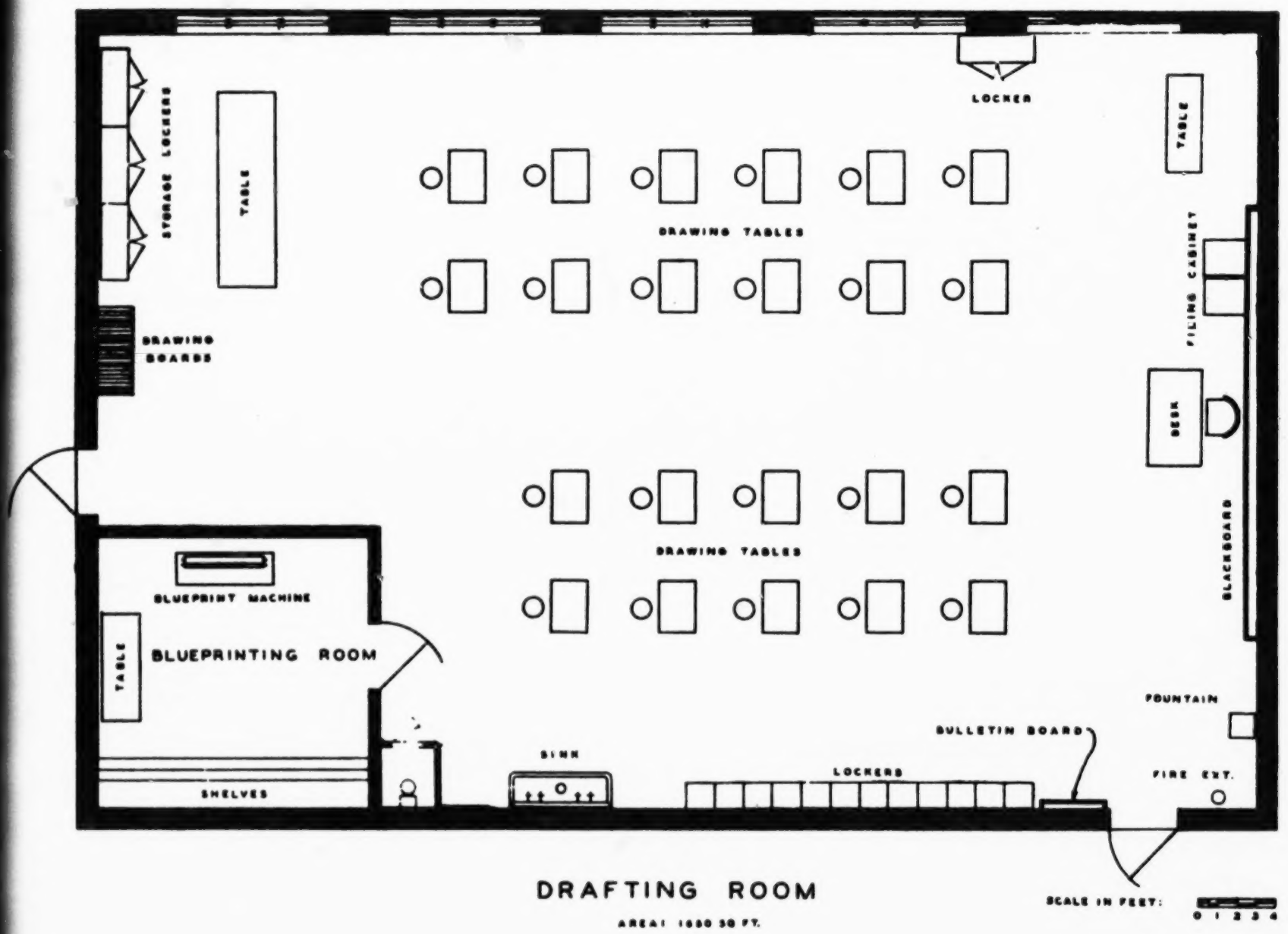
SHOP AREA: 2400 SQ. FT.

SCALE IN FEET: 0 1 2 3 4



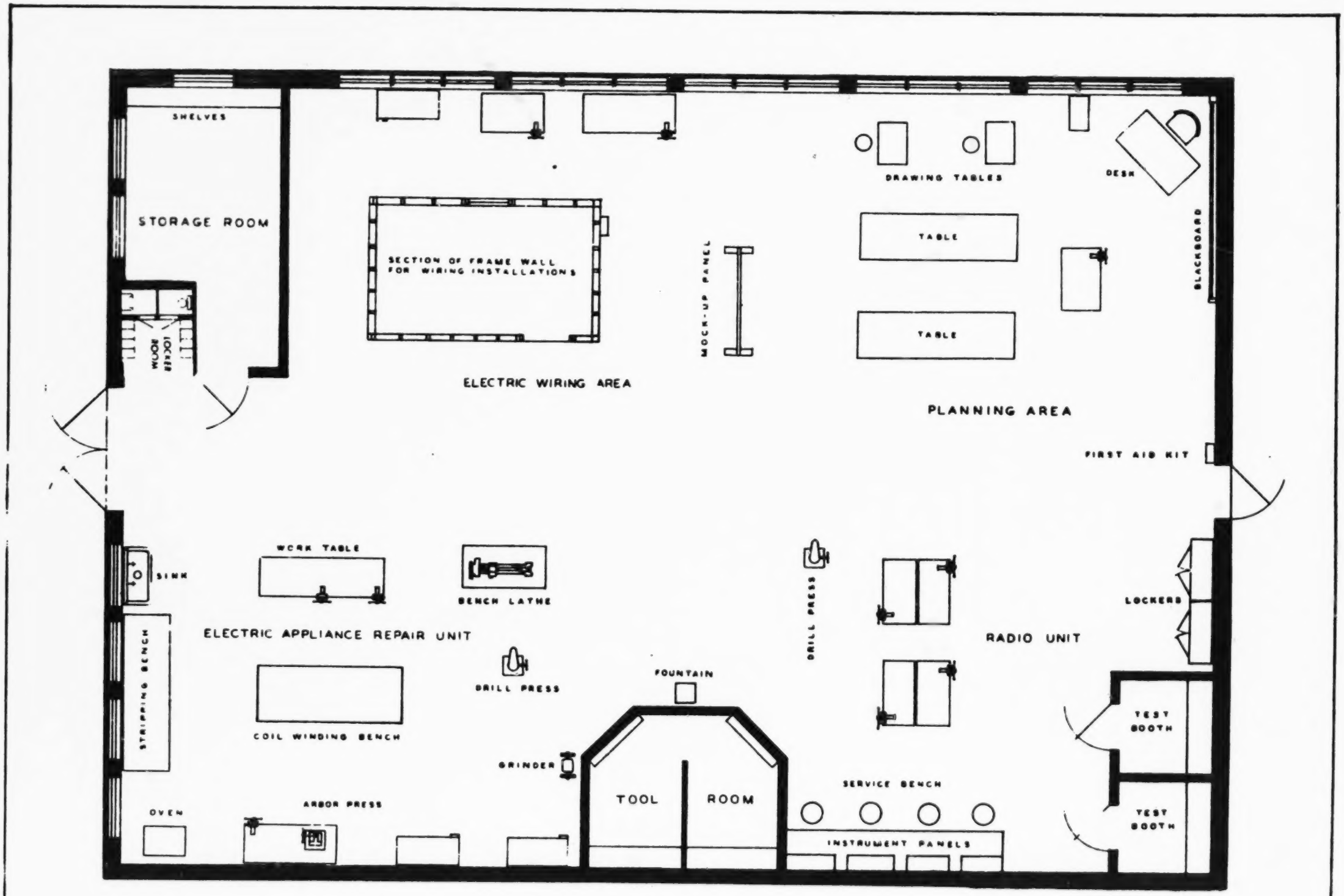
COSMETOLOGY SHOP

SHOP AREA: 3000 SQ. FT.



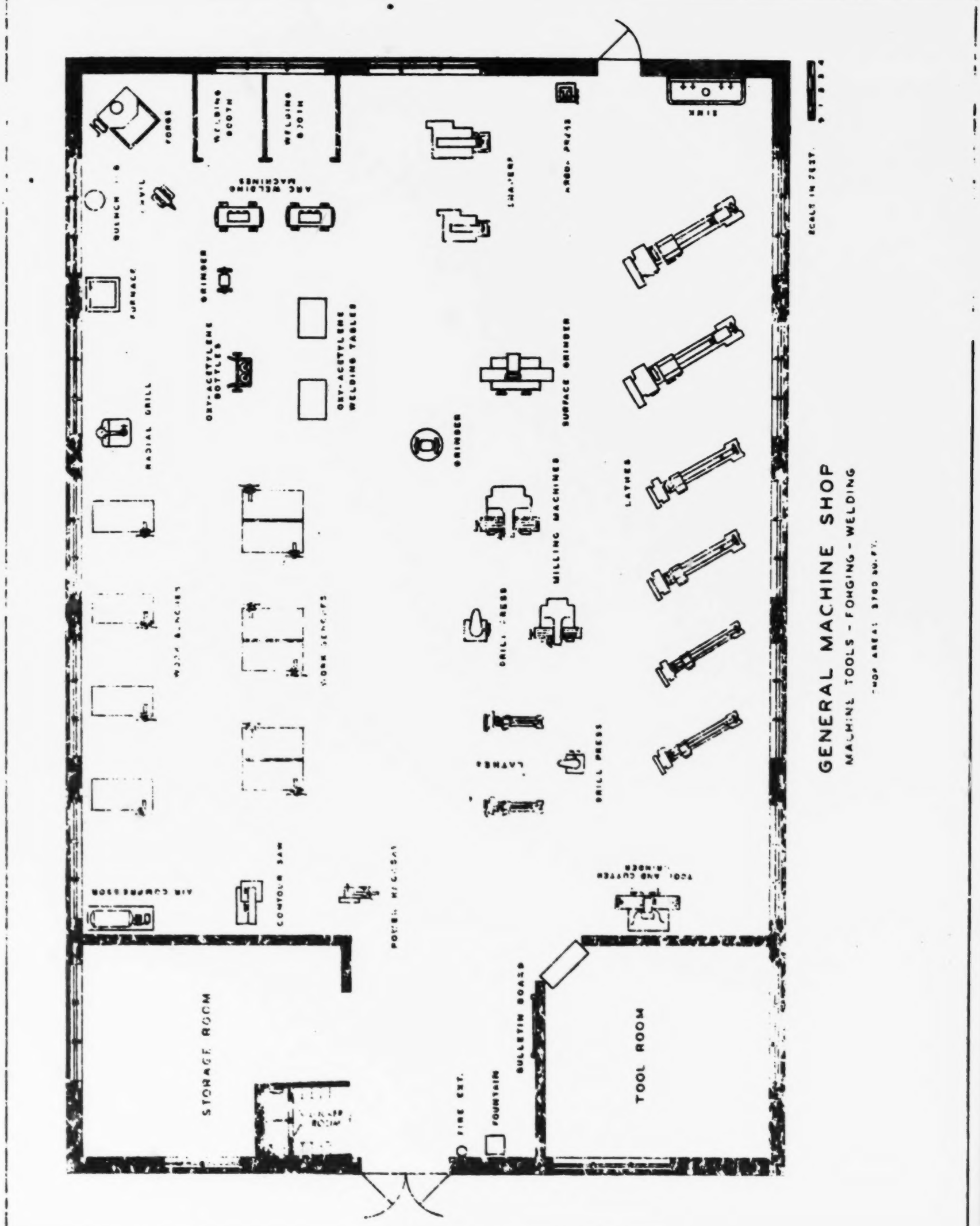
DRAFTING ROOM

AREA: 1080 SQ FT.



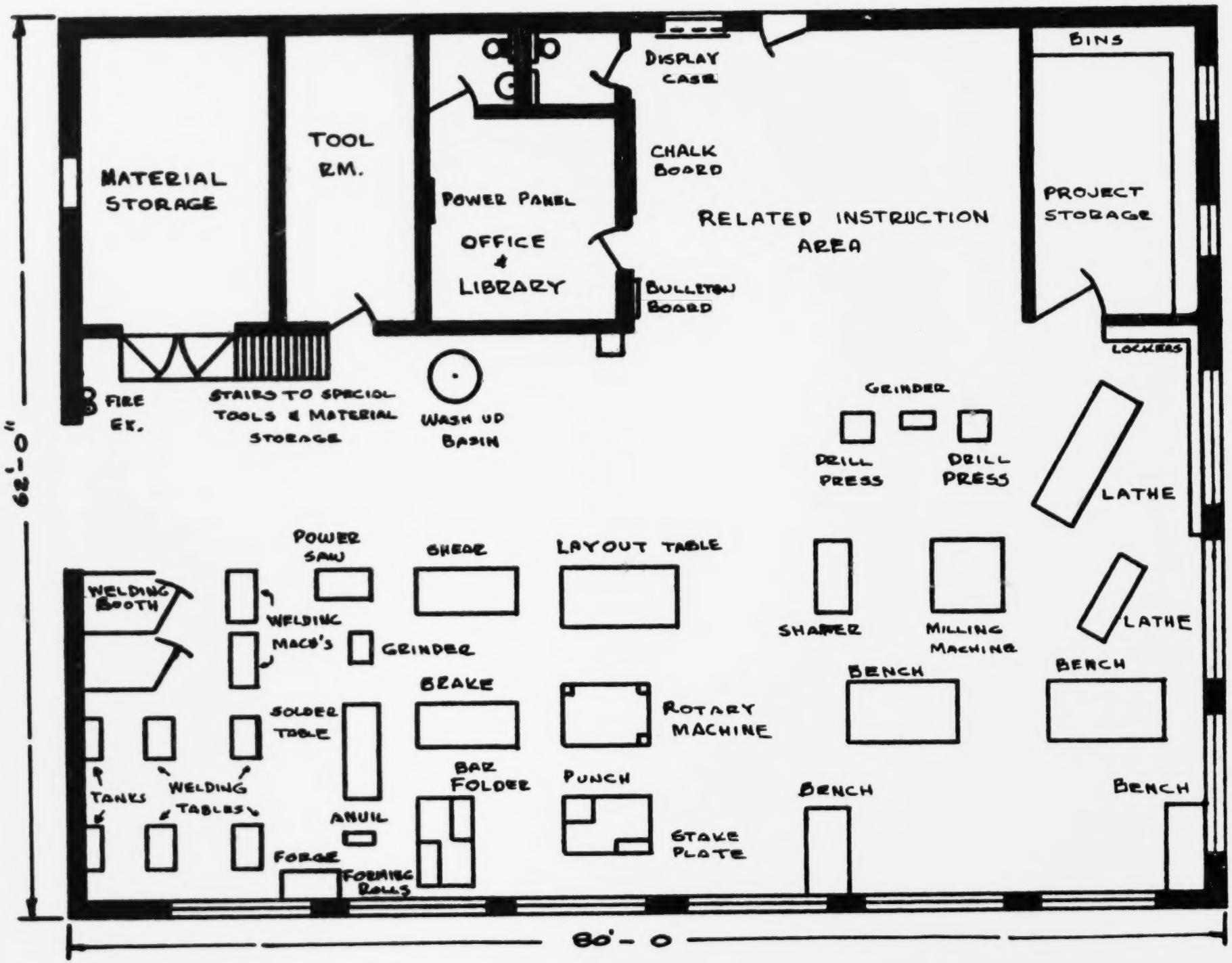
GENERAL ELECTRICAL SHOP

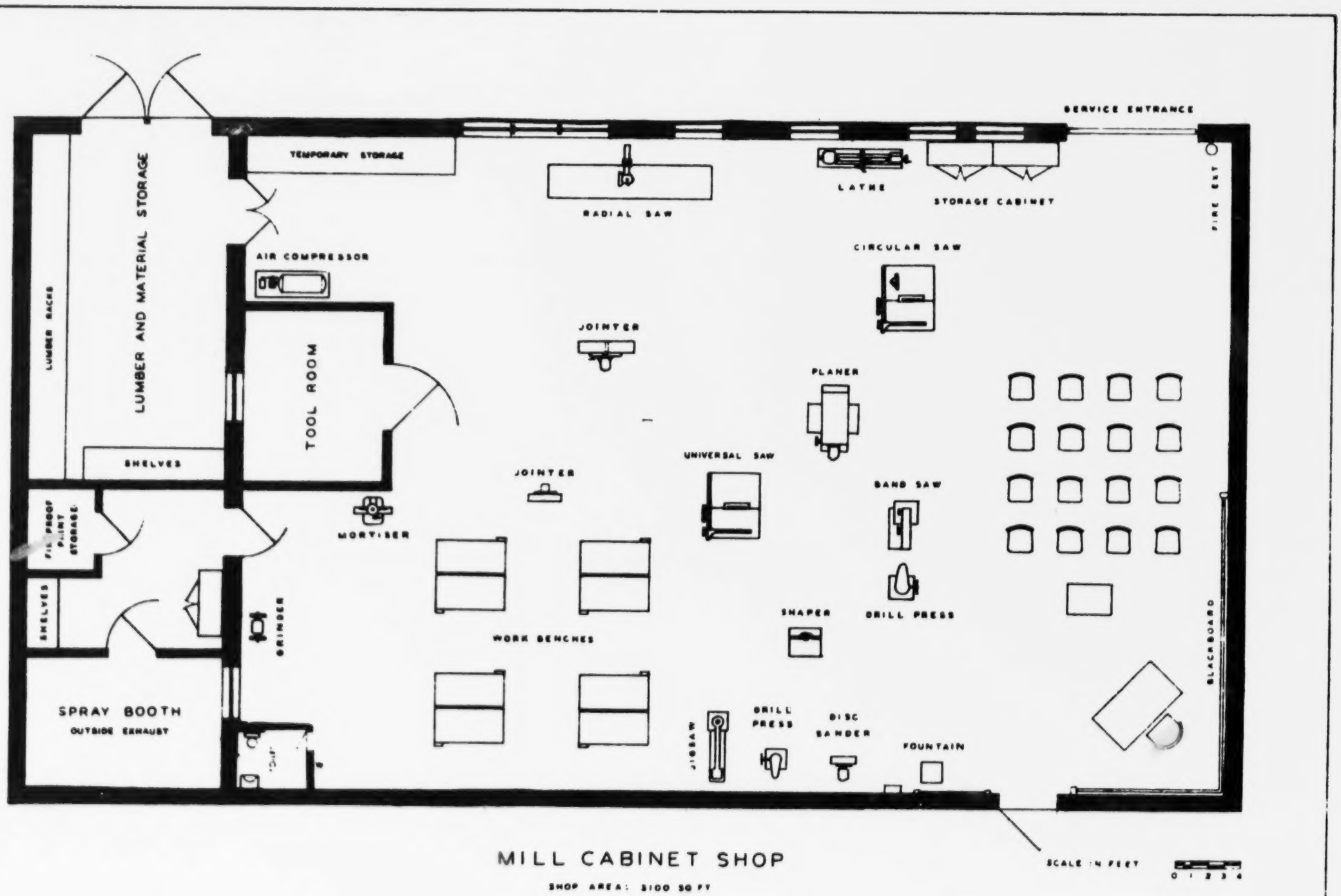
SHOP AREA: 3700 SQ. FT.


GENERAL MACHINE SHOP
MACHINE TOOLS - FORGING - WELDING
SCALE IN FEET
SINK
ARBOR PRESS
SHAPERS
WELDING BOOTH
WELDING BOOTH
ARC WELDING MACHINES
OXY-ACETYLENE BOTTLES
GRINDER
OXY-ACETYLENE WELDING TABLES
FURNACE
QUENCH
FORGE
RADIAL DRILL
GRINDER
SURFACE GRINDER
MILLING MACHINES
DRILL PRESS
LATHES
LATHES
DRILL PRESS
TOOL AND CUTTER GRINDER
AIR COMPRESSOR
CONTOUR SAW
STORAGE ROOM
FIRE EXT.
FOUNTAIN
BULLETIN BOARD
TOOL ROOM

METAL TRADES

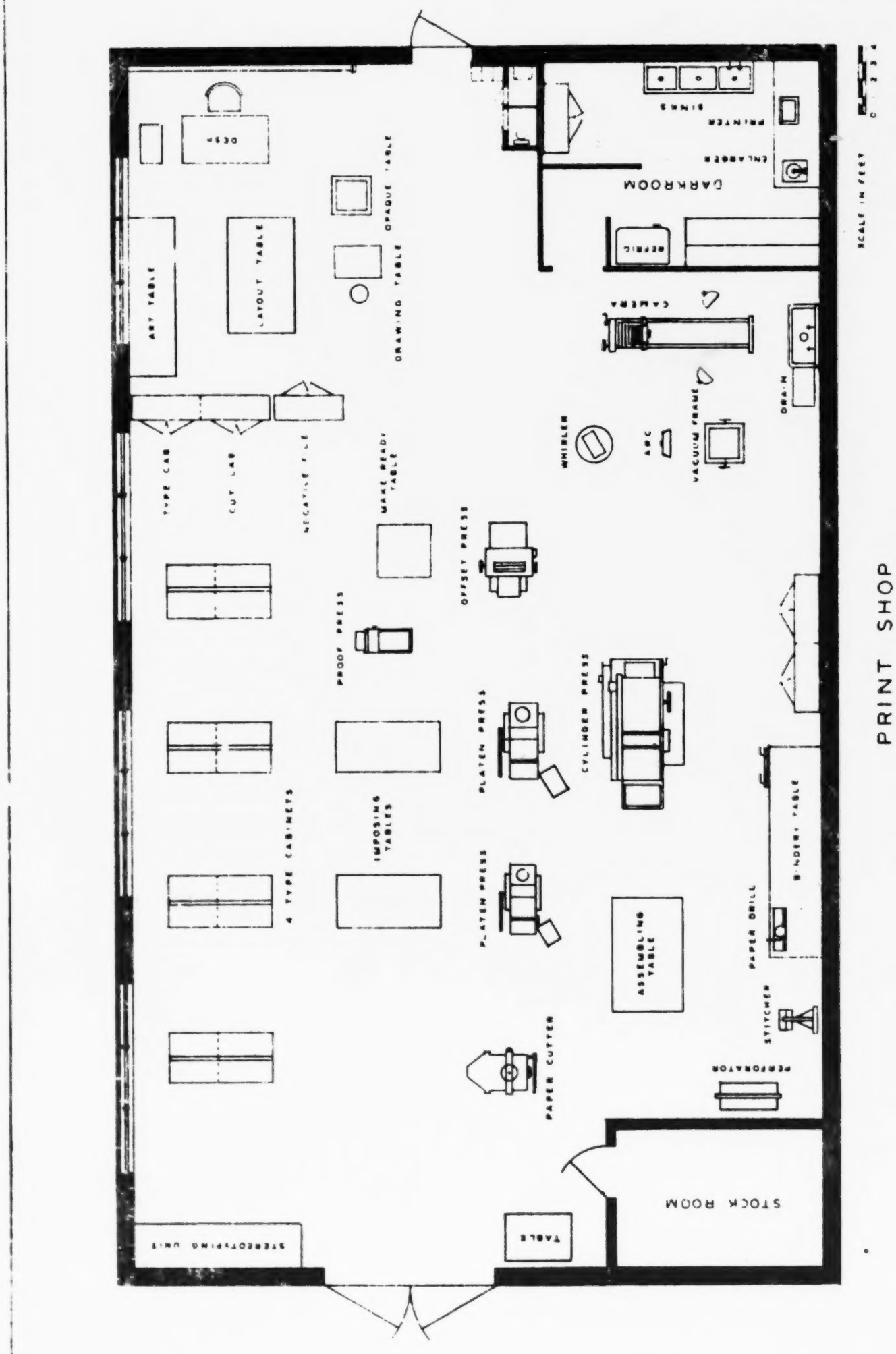
SCALE 3/32" = 1'-0"





MILL CABINET SHOP

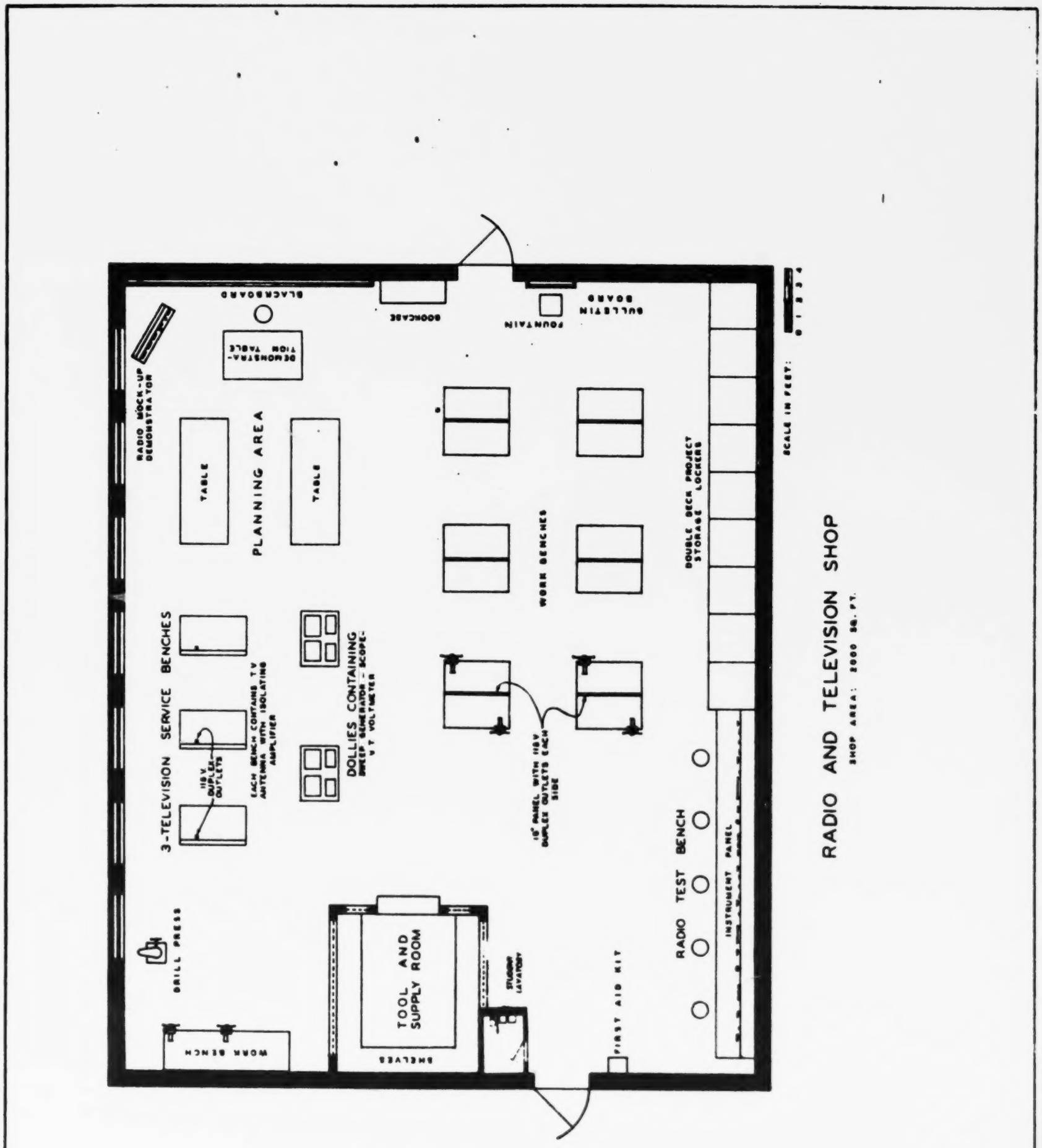
SHOP AREA: 3100 SQ FT

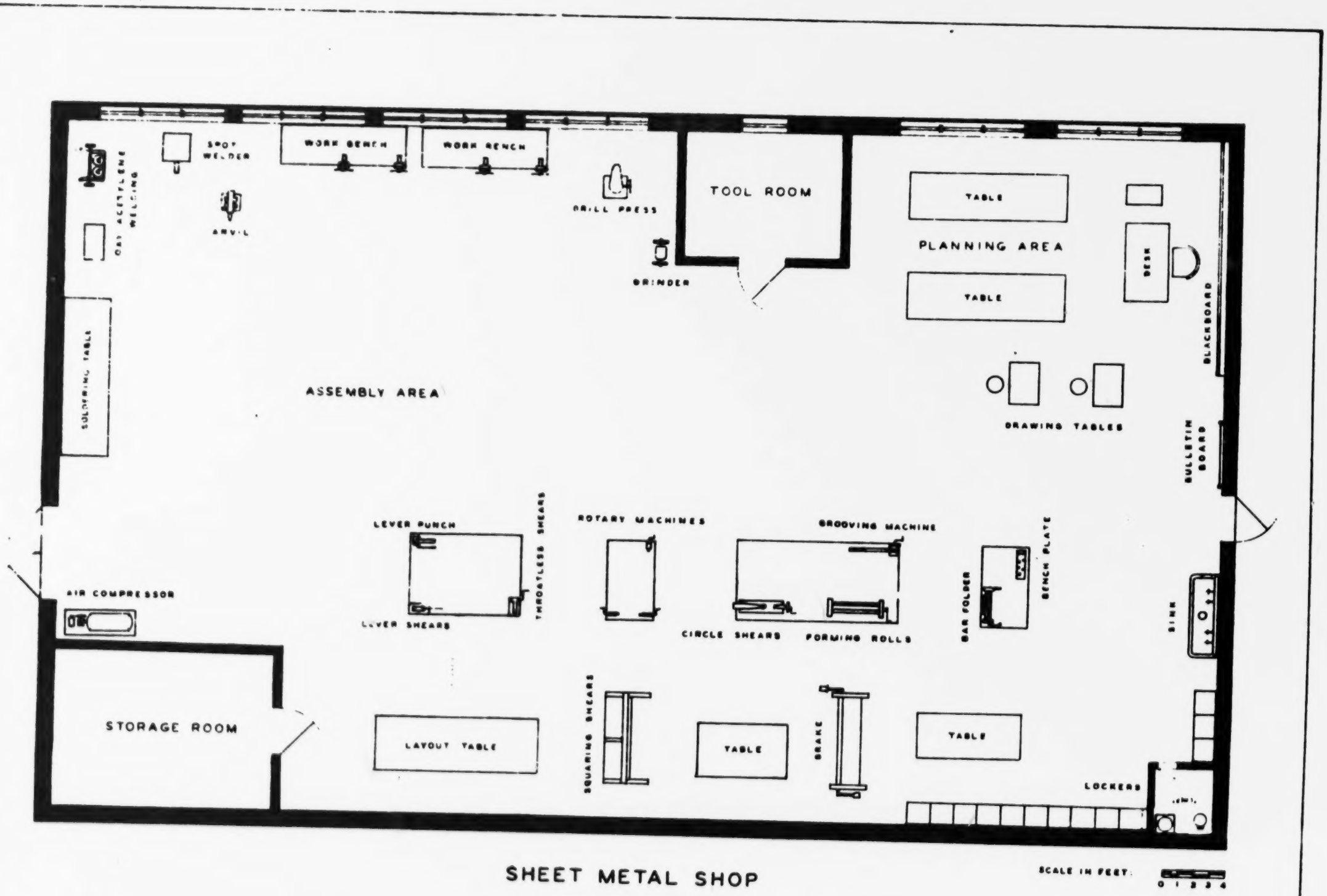


PRINT SHOP

LETTERPRESS AND OFFSET UNITS

SHOP AREA: 3000 SQ FT


RADIO AND TELEVISION SHOP
SHOP AREA: 2000 SQ. FT.
SCALE IN FEET: 0 1 2 3 4
BULLETIN BOARD
FOUNTAIN
BOOKCASE
BLACKBOARD
DEMONSTRATION TABLE
RADIO MOCK-UP DEMONSTRATOR
PLANNING AREA
TABLE
TABLE
WORK BENCHES
DOUBLE DECK PROJECT STORAGE LOCKERS
3-TELEVISION SERVICE BENCHES
110 V DUPLEX OUTLETS
EACH BENCH CONTAINS TV ANTENNA WITH ISOLATING AMPLIFIER
DOLLIES CONTAINING SWEEP GENERATOR - SCOPE - V T VOLTMETER
10' PANEL WITH 110V DUPLEX OUTLETS EACH SIDE
RADIO TEST BENCH
INSTRUMENT PANEL
DRILL PRESS
TOOL AND SUPPLY ROOM
SHELVES
STUDENT LAVATORY
FIRST AID KIT
WORK BENCH



SHEET METAL SHOP

SHOP AREA: 3500 SQ. FT.

SUGGESTED SHOP EQUIPMENT AND TOOLS

The following lists of equipment and tools are included to give school officials a general idea of the types and quantities of machines and tools required for different types of shops. They are not complete in every detail and are not intended to be used as purchase orders.

AUTOMOTIVE MECHANICS

TOOL AND EQUIPMENT LIST:

1-Caliper, 6" inside, spring type
1-Caliper, 6" outside, spring type
1 ea. Carburetor tool kit, complete set of overhaul tools for popular carburetors Carter, Rochester, Halley, Strombery
6-Chisels, cape 1/4"-6"
6-Chisels, cold 1/2"-6"
3- Chisels, diamond point 6"
1-Complete set of taps and dies and die stock and T-handle, uss, sae, NO 4 screw to 1/2
1-Dividers, 6" with replaceable points, spring type
1-Drill stand-fractional 1/16" to 1/2"
1-Flaring tool - 3/16" to 5/8" O. D. tubing size
1-Leaf type feeler gauge, brake drum and shoe
1-Tire gauge, 0-60 lbs. capacity
1-Screw pitch gauge, 60° V type thread, 22 pitches, 32 to 74
1-Thickness gauges, 6" blade, 8 tapered leaves, .002, .003, .004, .006, .008, .010, .012, and .015 leaves
1-Thickness gauge, 2 5/16" length blade, 22 blades, .004" to .025" cased
5-Machinist hammers, 12 oz. ball peen, forged steel
5-Machinist hammers, 24 oz. ball peen, forged steel
1-Sledge hammer, 7 lb. bell face, forged hardened
6-Soft face hammers, all hammers with wooden handles
6-Putty knives, 1 1/4" wide, 3 1/2" long tempered steel
1-Micrometer, inside diameter-calibrated to .001", range 2"-9 1/2", calibrated thimble with ground steel extension rods. Angular grooved extensions.
1 ea. Micrometer, outside diamater-drop forged 1" section frame. Anvil, spindle and barrel high quality ground steel. Standard calibrations sizes 0-1", 1-2", 2-3", 3-4$.
4-Oilers, 5 oz. 3" spout; steel can

2-Oilers, 1 pt. capacity 9" spout, hydraulic pump oiler
1-Oil stone, 4" x 1 3/4" x 1/2" medium
1-Oil measure, 2 qt. galvanized
2-Piston ring inserters
1-Pliers, 5" flat nose, cross-checked, forged tool steel
1-Pliers, 7" flat nose, long tapered forged steel
6-Pliers, 8" combination slip joint forged tool steel
6-Pliers, 7" diagonal
2 sets Punches, drive pin 8" knurled steel, set of 8: 1/16" dia. to 5/16" dia.
2-Punches, center 1/4 x 4"
4-Rules, 12" x 1" steel, graduated 1/8", 1/16", 1/32", 1/64".
4-Saws, hand hack, 8"-12" adjustable frame, 2 3/4" throat, with pistol grip handle
6-Screw drivers, 3" common
12-Screw drivers, 6" common 5/16" diameter
6-Screw drivers, 9 1/2" common 5/16" diameter
6-Screw drivers, 6" common 3/16" diameter
2 sets Screw drivers, offset, forged and tempered tool steel set of 6 for 3/16" to 3/4"
2 sets Phillips screwdrivers, set of 4 to fit No. 1, 2, 3, and 4
2 sets Clutch head screwdrivers, set of 4. No. 1, 2, 3, and 4.
2 sets Screw extractors
2-Scriber-1/8" dia. 10" double point
2-Snips, tin, straight 3" drop forged hardened tool steel
1-Snips, tin, curved 3" drop forged hardened tool steel
1-Soldering iron electric, 5/8" electric soldering copper, 200 watt complete with cord and stand
1-Square, steel, tempered 12" blade with forged square, center, protractor heads
1 set Stamps, steel, 3/16" hand cut figures 1 to 0
1 set Stamps, steel, 3/16" hand cut letters A to Z
3-Wrenches, 8" single and adjustable jaw, forged steel
3-Wrenches, 12" single and adjustable jaw, forged steel
2-Wrenches, pipe-10" length, 2" capacity, forged jaws
1 set Wrench, Spanner-adjustable hook, drop forged, set of 3, 3/4" to 4 3/4" diameter
1-Wrench, spanner-adjustable face spanner, drop forged
1-Wrench, Allen, one set of 11
5-Wrenches, double broached hex, double offset drop, forged chrome alloy steel, guaranteed (short length) 4 1/2" to 6" size from 3/16" to 11/16"
2-(long length) 8" to 19" size from 5/16" to 1"
2 sets Wrenches, ignition and electrical open end, double end, set of 9:13/64" to 5/16"
5 sets Square drive socket wrench set, 1/2", including sockets, U. joint. Extensions, 3 lengths, and 4 drive handles.
2 sets Square drive deep socket wrenches, 1/2"
5 sets Wrenches-3/8" square drive socket wrench set including sockets, U. joint, 3 extension and 4 drive handles, speed, henged offset, ratchet, sliding offset

1 set Wrenches, set of 3/8" drive deepsockets, open end
5 sets Wrenches, set of open ends, 1/4" to 1" openings
2 sets Wrenches, tappet
1-Equipment and testing devices. Air compressor
As needed - Airlines and chucks
1-Aligning jig - for connecting rods
1-Arbor press - 25 ton hydraulic
3-Carriers (battery equipment)
1-Slow charger - 6 and 12 volt (battery equipment)
1-Fast charger - 6 and 12 volt (battery equipment)
2-Hydrometers (battery equipment)
1-Syringe and container (battery equipment)
1-Volt meter, prong type (battery equipment)
8-Benches, work with vices (4" vice)
1-Bench, work portable with vice
1-Reliner - combination riveter and grinder (brake equipment)
2-Brake bleeder (brake equipment)
1-Lining bonder and remover (brake equipment)
1-Drum lathe with necessary attachments, drum micrometer, cylinder hone, lining clamps (brake equipment)
1-Lining grinder with necessary adapters to grind and centralize brake shoes
4-Containers-pans, galvanized radiator drain with pour spout
6-Containers - can, waste, galvanized
1-Chain hoist - with overhead trolley and monorail, 3 ton capacity
1-Steam or solvent type (cleaner parts)
1-Ring groove cleaner
8-Cord - extension light, complete with rubber handle and socket, outlet on handle, 25' length
8- Creepers - 4 universal casters
1-Drill, electric portable 1/4"
1-Drill, electric portable 1/2"
1-Drill, press 21" with motor and chuck
8-Pairs of fender covers
1-Cylinder gauge, dial indicator, universal type attachments complete in case
1-Compression gauge, dial face
1-Grease dispenser - chassis pressure type
1-Grease dispenser - transmission lube dispenser
2-Grinders - electric bench grinder, 2 six-inch dia. wheels with motor, switch, gards, and tool rests
1-Grinder - cylinder, with motor and hone, use with drill
1-Growler, 110 V-60 cycle, for testing generator and starter armatures
1-Honing machine - electric motor driven, for piston pins, king pins, etc., with mandrels 1/8" to 2 5/8" inside diameter
4-Jacks - floor roller, hydraulic 2 ton
1-Jack - hand stationary jack, hydraulic type, 1 1/2 ton lifts
1-Lift - automobile, hydraulic, twin post
1-Lift - automatic transmission, hydraulic lift
1-Meter - AVR 75 ampere D. C. 6, 12 and 24 volt scales D. C. complete with standard load resistors. Encased in durable portable case with heavy leads and clips attached.

1-Meter - ammeter,-30 amp. capacity
1-Meter - voltmeter, 10 volt rating
1-Pullers, 1 complete set for all types of jobs as needed
1-Radiator hydrometer, calibrated for alcohol, glycerine, and ethylene glycol with built in thermometer
1-Spring tension scale - brush and point, 0-48 oz., with book prong
1-Spring tension scale - steering gear scale, 0-4 lbs.
16-Stands - car stands (horse) 2 ton min. cap
1-Stands - engine build up stand, 360° swing
1-Rear axle overhaul stand
1-Coil tester
1-Condenser tester
1-Distributor tester, tachometer
1-Mutor tester analyzer - M. M. T.
1-Power timing light
1-Sparkplug cleaner and tester
1-Headlight tester
1-Thermometer tester, fahrenheit scale
1-Vacuum and fuel pump tester
1-Bead expander (tire service)
1-Tire changer with bead breaker
1-Tire gauge
1-Tire tester (water tank)
1-Tire repair kit (tubeless)
1-Valve refacer with adjustable base, 110 v. 60 cycle motor-priced with seat grinder
1-Valve seat grinder, complete with stones
1-Valve spring compressor, adjustable for L-Head engines
1-Valve spring compressor, adjustable for overhead valves
1-Test rack with front pit preferred (wheel alignment equipment)
1-Three-way alignment gauge set for camber, caster, and kingpin inclination, including adapter sleeve and clamp to fasten to spindle, and turning radius plates
1-Toe-in gauge (wheel alignment equipment)
1-Wheel balancer, static and dynamic
File Card
Assorted small tools as needed
File, assorted as needed
Cylinder boring bar
Oxy-acetylene welding unit complete with regulators, tips, hose, and cutting tip.

GENERAL BUILDING TRADES

2-Portable electric saws
1-3" portable sander
2-Carpenter's levels
4-Jack planes
2-Smooth planes
2-Plumb bobs
4-Coping saws
4-6" screwdrivers
4-8" screwdrivers
2-10" screwdrivers
4-4" screwdrivers
2-2" screwdrivers

1-Rachet screwdriver 4"
1-Spiral screwdriver - 670 A
4-Tin snips
4-Try and mitre squares
4-Combination squares
1-100 foot steel tape
1-50 foot steel tape
1-Carpenter's transit
1-Wheelbarrow
4-Electrician's pliers
1-18" table saw (portable)
1-6" jointer (portable)
4-2" x 8" oil stones
2-8" combination pliers
4-1/4" wood chisel
4-1/2" wood chisel
4-3/8" wood chisel
4-5/8" wood chisel
2-1" wood chisel
1-1 1/2" wood chisel
1-Pole ax
2-Hatchets
2-T bevels
4-Bit braces (rachet)
1-Hand drill (3/8" capacity)
1-Set twist drill H. S.
2-Concrete edger
1-Concrete jointer
2-Adjustable hacksaw
20-16 oz. nail hammers
8-13 oz. nail hammers
1-18" pipe wrench
1-14" pipe wrench
2-10" pipe wrenches
1-Pipe vise 1/8" to 2" cap
1-Steel mitre box with saw
1-18" planer
1-Radial saw
1-Set auger bits 4 to 16
2-Bit gauges
4-Mason's trowels
4-Brick spacing rules
1-Brick hammer
2-Mason's levels
2-1 1/4" putty knives
4-3 1/2" taping knives
2-4" taping knives
3-11" plaster trowels
30-6 foot extension rules
12-Nail sets (assorted)
1-5 1/2 point hand saw
6-8 point hand saws
4-10 point hand saws
2-Expansion bits 7/8" to 3"
2-Tack hammers
8-Spades and shovels
1-Portable spray equipment
1-Drill press 15" floor model
1-Mortice attachment for drill press
1-Vibrator sander
1-Jig saw
1-Table saw (10" tilting arbor)
4-Workbenches
8-Bar clamps
8-6" C Clamps
8-6" handscrew clamps (No. 1)
Reference and textbooks
1-Dado set for table saw
1-Edge tool grinder
1-8" jointer
1-Router and Builder's Kit
1-Portable electric drill 1/2" Cap

Note: Some type of flat bed truck is recommended for use in this program.

DRAFTING

TOOLS AND EQUIPMENT

Instruments listed below should be made available to each student:

1 only, 30-60 triangle, 8"
1 only, 45 triangle, 8"

1 only, Bench duster
1 only, Architect's scale, 12"
1 only, T-Square, 24"
1 only, Drawing board 18" x 24"
1 only, Drawing instrument set

Instruments listed below may be stocked in limited quantities for general use:

1 only, Leroy lettering set, complete
3 only, Drafting machines
3 only, Electric eraser (small)
1 only, Proportional divider
1 only, Beam compass
1 only, Drop Bow Pen and pencil combination compass
6 only, Contour pen
6 only, Engineer's scale, 12"
1 only, Spring inside caliper
1 only, Spring outside caliper
1 only, Vernier caliper
1 only, Micrometer caliper
1 only, Lesh angle
12 only, French curves, mixed sizes
1 only, Paper cutter, 15"
1 only, Shears, trimming, 14" or 16"
1 only, Metal cash box
1 only, Blueprint frame, 22" x 30"

FURNITURE:

1 only, per student, Drafting table, and stool
1 only, Instructor's drawing table
1 only, Bookcase assembly
1 only, Storage case assembly
1 only, Wall sink assembly--30" x 20" x 10" deep sink
1 only, Filing cabinet, steel, 4 drawer

ELECTRICAL TRADES

STOCKROOM TOOLS

15-Side cutting pliers 7"
15-Diagonal cutting pliers 6"
15-Long nose, side cutting pliers 6"
6-Adjustable offset pliers
15-Soldering iron 150 watt
5-Soldering guns 150 watt
5-Phillips screwdriver 3" #1 (plastic handle)
5-Screwdriver 2 x 1/8"
5-Screwdriver 3 x 3/16"

10-Screwdriver 4 x 1/4"
10-Screwdriver 6 x 1/4"
5-Screwdriver 8 x 1/8"
1-Tube puller
2-Alignment kit
4-Slip joint pliers (combination)
1-Drill motor 1/4"
1-Drill set 1/32" to 1/4" in 32nds
1-Drill set 1/4" to 1/2" in 32nds
2-Hand drills
2-Combination square
1-Center punch
1-Socket punch set 5/8", 3/4", 1", 1-1/8", 1-3/16"
4-Hacksaw and blades
1-Tin snips, 12"
4-Cold chisel, 1/2"
5-Mill files, 10" bastard
2-Swiss files, #4

TEST EQUIPMENT

4-Volt-ohm-milliammeter, 1000 ohms per volt (kit-form) Eico-model 566 or equal
1-Volt-ohm-milliammeter, 20,000 ohms per volt. Simpson model 260, or equal
2-Vacuum-tube-voltmeter, (kit-form) Health-kit model VTVM or equal
1-Tube tester, Dynamic mutual conductance type (any reputable manufacturer, such as Hickok, Jackson, Simpson, or Precision)
1-Picture tube tester-rejuvenator, B & K
1-Signal Generator, precision model E-200-C or equal
1-Condenser tester, Sprague model To-5 or equal
1-Condenser substitution box, (kit-form) Eico model 1120 or equal
1-Resistor substitution box, (kit-form) Eico model 1100 or equal
1-Oscilloscope (kit-form) Healthkit O-11 (wideband) or equal
1-Isolation transformer, variable, Stancor PV-6443
1-Megger, 500 volt
1-Amprobe Jr.
15-Test light

EQUIPMENT

1-Drill press 1/2" chuck
4-Vise, 3" jaw
1-Grinder-buffer, 6" combination
1-Coil winder
1-Bake oven
15-Electrical test benches (can be made and wired in shop cheaper)

METAL TRADES SHOP

ARC WELDING UNIT

3-D. C. arc welders-300 ampere size
1-A. C. arc welder-200 ampere size
4 sets electrode and ground cable
6-head shields
2-hand shields
1-gas cutting machine
1-hand grinder
1-exhaust system over booths-local manufacture
4-tongs
4-chipping hammers
4-wire brushes
4-chipping goggles
6-leather sleeves (assorted sizes)
1-grinder pedestal wheel size 14" x 2"
1 doz. C-clamps (assorted sizes)
2-pipe bar clamps
4-welding booths (local manufacture)
4-welding tables (local manufacture)
1-scrap disposal bin (local manufacture)

NOTE: Layout tools are not listed here. See Bench Metal and Sheet Metal List.

SHEET METAL UNIT

1-set of bench stakes
1-bench plate
2-work benches-60 x 48 x 32"
1-adjustable bar folder
1-burring machine
1-turning machine
1-wiring machine
1-combination crimping and beading machine
1-setting down machine
1-slip roll forming machine 36" 22 gauge
1-rotary circular shears
1-squaring shears-36" capacity
1-cornice brake with stand-4 ft.
4-scratch awls
2 each wing dividers 8"
2 each wing dividers 10"
2 each wing dividers 12"
4-steel squares
1-trammel points
1-circumference rule
3 each set of punches, center, solid, prick
1 set of chisels, flat, cope, round nose, diamond point

1-set of hand groovers
1-set of rivet sets
2 each hammers, riveting, setting, raising, ball pein mallet
3-snips, combination
2-snip, aviation, right and left cut
2-snip, compound lever
1 pair pliers, flat nose
1 pair pliers, round nose
3 pair pliers, combination
1-hand seamer
1 set of soldering coppers (2 ea. of 1 lb, 2 lb, 3 lb.)
1-hacksaw frame adjustable
4 each files, 12" long, smooth and bastard cuts, flat, mill, knife, three square, square, round and half round
1-sheet metal gage
2-vise clamp wrenches
4-flexible steel rulers

BENCH METAL WORK UNIT

1-work bench for 4 vises 40 x 60 x 32" high
4-machinists' vises
4-hand hacksaws (adjustable frames)
4 each files-12" long, smooth and bastard cut, flats, squares, rounds, tapers, half rounds, knife, warding, piller, and mill
1 doz. file handles
1 each hammers, ball pein hammers 4 oz., 8 oz., 12 oz., 16 oz., 20 oz., 24 oz., 32 oz.,
1-blacksmith's hand hammer 40 oz.
1 each hammers, rawhide faced, plastic faced, brass faced, rubber faced
1-sledge hammer, one 8 lb.
1 set flat chisels
1 set cape chisels 1/8", 3/16", 1/4", 5/16"
1 set round nose chisels 1/8", 1/4", 1/2"
1 set diamond point chisels 1/8", 1/4", 1/2"
1 set taper punches (points) 3/32", 3/16", 1/4", 3/8"
1 set straight pin punches (3/32", 1/8", 5/32", 3/16", 7/32", 1/4")
1 set center punches
4-scribers
2-flexible steel rules (10 ft. lengths)
4-combination square sets
2 each spring dividers, 4", 6", 8"
1 set of box wrenches
1 set of open-end wrenches
1 set of socket wrenches (1/2" drive)
1-adjustable face spanner wrench (3/16" pins)
1 each adjustable end wrenches, 6", 8", 10", 12", 15", 18"
1 each pipe wrenches 8", 12", 14"
1 each pliers, electricians pliers, long nose pliers, diagonal pliers, slip joint combination pliers, end cutting nippers
1 set of taps and dies, national fine no. 0 size to 1 inch

1 set of taps and dies, national course no. 1 size to 1 inch
1 set of taps and dies, national special no. 1 size to 1/2 inch
1-rectangular combination oil-stone 6 x 2 x 1
1 set fillet and radius gages 1/32" to 1/2" by 64ths
1 set screw pitch gages (4 threads to 84 threads)
1 set of screwdrivers (assorted sizes)
1 set of twist drills, 1/16" to 1/2" straight shank
1 set of twist drills 1/2" to 1" taper shank (select taper shank size to fit your press)
1 set of twist drills, No. 1 to 60
1 set of steel letters and figures 1/8" size
1-machinist's level

MACHINE TOOL UNIT

1-engine lathe standard change 9" x 4 ft. attachments and accessories
2-engine lathe quick change 4 ft. x 6 ft.
1-milling machine, no. 2 with vise
1-shaper 12" stroke
1-grinder pedestal 10" x 1" wheels
1-power hacksaw
1-drill press, 14" bench model, Jacobs chuck 1/2" cap
1-drill press, 20", floor model, No. 3 or 4 morse taper spindle
1-arbor press and pedestal
1-stock rack (local manufacture)
1-milling machine cutter,lathe tool cutter bits,shaper tool cutter bits
4-micrometers 0-1" (outside)
2-micrometers 1-2" (outside)
1-micrometers 2-3" (outside)
1-inside micrometer set 2 to 8 inches
1 set of telescoping gages 5/16" to 3" cap
1-depth micrometer set 0-3" cap
1 set taper pin reamers 0-5
1 set morse taper reamers no. 1 to no. 4
1 set taper shank reamers 1/4" to 1"
1 set counterbores and spot tracers
1 set quick-set adjustable reamers 15/32" to 1 1/2" cap
1 set of V blocks
4-outside calipers 8"
4-inside calipers 8"
2-hermaphrodite calipers 8"
4-hook rules 6" (narrow)
1 set of taper sleeves
2-Jacob's chuck 1/2" cap. (morse taper shank to fit equipment)
Assortment of T slot nuts and bolts to fit slots in machines ordered
1-surface plate
1-surface gage
2-dial indicator sets
1 set of center drills and countersinks
3-center gages

1 set of mandrels
12-oilers, hand
Assortment of lathe dogs 3/8", 1/2", 3/4", 1", 1 1/4", 1 1/2", 2", 3"

MACHINE SHOP

TOOL AND EQUIPMENT LIST

3-Sensitive drill press (bench or floor model), size 15"
1-Upright drill press
1-Radial drill press, 3 ft. arm
2-Grinders (double wheel, bench or pedestal), 6-8" wheel
2-Grinders (double wheel, pedestal)10-14" wheel
2-Disc sanders, 15"
1-Belt sander, 4" x 60"
6-Oxy-acetylene welding outfits
4-Arc welding outfits, 300 amp
1-Upright metal cutting band saw
1-Power hacksaw
1-Tool grinder, with attachments
1-Surface grinder
8-Engine lathes (with motor, complete tooling) 10" x 3'
6-Engine lathes (with motor, complete tooling) 13" x 5'
2-Engine lathes (with motor, complete tooling) 16" x 6'
1-Engine lathe (with motor, complete tooling) 30" x 8'
2-Milling machines (Universal)
2-Milling machines (Vertical)
2-Shapers, 10"
2-Shapers, 18"
1-Turret lathe (with tooling) No. 3
Hand tools (hammers, punches, chisels, pliers, wrenches, screwdrivers, files, hacksaws)
3-Dial test indicators (complete)
Assorted fixed gauges
3-Drill sets: Fractional, 1/64" to 2"
3-Drill sets: Numbered, 1 to 60
3-Drill sets: Letter, A to Z
3 sets Taps: N. C. and N. F. series, No. 4 screw to 1" bolt
3 sets Dies: N. C. and N. F. series, No. 4 screw to 1" bolt
Clamps ("C" and Parallel), assorted
Centerdrills, countersinks, spot facers, assorted
5-Tap and die handles
Reamers (straight and tapered), assorted
Precision measuring instruments (mikes, verniers, dial indicators)
Other measuring instruments calipers, rules, gauges, assorted
18-Bench vises, swivel base, 4" jaws
Work benches
Lathe tools and attachments (boring bars, knurling tools, dogs, drill chucks, sleeves), assorted
1 set Pipe taps and dies, 1/8" to 2"

1 ea. Pipe wrenches, 8", 12", 18"
1-Pipe cutter, 1/8" to 2"
6-Drill press vises, 3"
2-Hand drill, 1/4" capacity
1-Hand drill, 1/2" capacity
2-Anvil, 150-200 lb.
1-Arbor press, 3 ton

RADIO AND TELEVISION SHOP

TOOLS AND EQUIPMENT

This list is based on an enrollment of 15 class members.

10-Volt-ohm-milliammeter, 1000 ohms per volt (kit-form) Eico-model 566 or equal
5-Volt-ohm-milliammeter, 20,000 ohms per volt. Simpson model 260 or equal
5-Vacuum-tube-voltmeter, (kit-form) Heath-kit model VTVM
1-Tube tester, dynamic mutual conductance type (any reputable manufacturer, such as Hickok, Jackson, Simpson, Precision)
1-Picture tube tester-rejuvenator, B & K Instrument Co. or equal
3-Signal Generator, Precision model E-200-C or equal
1-Audio Oscillator, Jackson model 655
1-Condenser tester, Sprague model TO-5
3-Condenser substitution box, (kit-form) Eico model 1120
3-Resistor substitution box, (kit-form) Eico model 1100
3-Oscilloscope, (kit-form) Heath-kit O-11 (wideband) or equal
1-*Sweep and marker generator, Philco model 7008 (combination, with 3" oscilloscope)
3-Isolation transformer, variable, Stancor PV-6443

* This generator is necessary only if alignment procedures are to be taught. May be purchased later in the program if desired.

TOOLS

15-Tool boxes (containing the following hand tools):

1-Combination pliers 6"
1-Diagonal cutters 5" or 6"
1-Long nose pliers 6"
1-Screwdriver 2 x 1/8"
1-Screwdriver 3 x 3/16"
1-Screwdriver 4 x 1/4"
1-Screwdriver 8 x 1/8"
1-Phillips screwdriver 3" No. 1
1-Spin-tight 1/4"
*1-Soldering iron (100 watt American Beauty 3/8" tip or equal) and holder (or soldering gun for TV students only)

1-Tube puller
1-Alignment kit

* A minimum of two (2) boxes should be equipped with soldering guns, dual 135 watt. Not recommended for beginning students.

STOCKROOM TOOLS

1-Drill motor, 1/4" portable
1-Drill set 1/32" to 1/4" in 32nds.
1-Drill set 1/4" to 1/2" in 32nds.
2-Hand drill
2-Combination square
1-Center punch
4-Work stand, 28" square plywood top - steel frame 28" high, on 3" rubber casters (shop made)
1-Socket punch set 5/8", 3/4", 1", 1-1/8", 1-3/16"
2-Hacksaw and blades
2-Tin snips, 12"
1-Chisel, (cold, 1/2")
1-Set of files
1 Set of taps (small) 4-40 to 1/4-20
2-Hammer, 8 oz. ball-pein
1-Mallet, plastic
1-Wrench set, open end to 1"
1-Nut driver set no. 6 to 18
1-Socket wrench set (small 1/4" drive)
4-Crescent wrench, 6"
1-Allen wrench set
1-Spline wrench set
1-Tube pin straightener (7 and 9 pin)
2-TV mirror (on stand with casters) shop made
1-Wire gauge, American Standard
2-Wire strippers (automatic hand type)
1-Micrometer, 1" (Starrett)
2-Scribe

BENCH TOOLS

1-Drill press, 1/2" chuck table model
2-Vise, 3" jaw
1-Grinder-buffer, 6" combination
1-*Box bender, 24" (Berkroy or equal)

* Not required if available in sheet-metal shop.

STOCKROOM SUPPLIES

This list is based on an enrollment of 15 students.

NOTE: Usable parts may be obtained from salvaging old radios and TV

receivers. In most cases these may be obtained free of charge from service shops, however, some shops may wish a small payment.

Tubes that are stocked will depend upon the availability of replacement from a wholesale house. If the jobber is near at hand the number of tubes may be reduced to the ones necessary to perform the jobs listed in the laboratory manuals. Tubes for live jobs may then be purchased when required.

The following list will contain only those parts needed to perform the jobs listed in the lab manuals:

10-Power supply, variable, 300 v. @ 50 m. a. (see diagram in instructor's guide for Basic Television and Television Receiver Servicing, McGraw-Hill.) Student constructed.

TUBES
10--5 Y 3
15--6 F 6
15--6 J 5
10--6 S A 7
15--6 S J 7
15--6 S K 7
5--6 S N 7
15--6 S Q 7
5--35 W 4
5--50 C 5
2--5 A X P 4

Note: If popular radio and TV tubes are to be stocked a list of the most frequently used tubes per 1000 may be obtained from any tube manufacturer free of charge. Common practice is to stock two (2) of each tube if the frequency chart is not followed.

RADIO PARTS
20--Batteries 1:5 V and 4:5V, 22.5V
5--Coils, antenna (loop-stick and loop)
5--Coils, oscillator
5--Coils, IF (455 kc and 262 kc)
5--Chokes, RF, 2.5 mh
2--Chokes, filter, 50 ma 10 hy
1-Compass, magnetic, 1" (local purchase)

CAPACITORS
2--80 mfd 450 volt
2--40 mfd 450 volt
5--20 mfd 450 volt
15--8 mfd 450 volt
15--20 mfd 150 volt
10--50/30 mfd 150 volt
10--25 mfd 50 volt

10--.1 mfd 600 volt paper
15--.05 mfd 600 volt paper
20--.01 mfd 600 volt paper
10--.005 mfd 600 volt paper
20--.001 mfd 600 volt paper
10--.0005 mfd mica or ceramic
20--.00025 mfd mica or ceramic
10--.00005 mfd mica or ceramic
5--Speakers, 5"
10--Lamp, neon, NE-51
5--Volume control, 25,000 ohm
10--Volume control, 500,000 ohm
4--Selenium Rectifier, 75 ma and 100 ma
5--Switch, SPST, toggle
5--Transformer, AF output (6F6 to VC)
2--Transformer, AF output(PP 6F6 to VC)
2--Transformer, AF interstage 3-1
5--Transformer, Power, 300-0-300 v. @ 50-70 ma., 5 v @ A., 6.3 v. @ 3a.

RESISTORS (1 watt composition @ .10)
2--150 ohm
4--270 ohm
5--470 ohm
5--1000 ohm
5--2200 ohm
5--2700 ohm
10--4700 ohm
10--12000 ohm
10-22000 ohm
10--27000 ohm
20--47000 ohm
20--120000 ohm
20--270000 ohm
20--470000 ohm
10--1.2 megohm
10--2.2 megohm
10--4.7 megohm

RADIO HARDWARE
10--Alligator clips
50--Tube sockets, octal
10--Tube sockets, 5 prong
10 ea. Tube sockets, 7 and 9 pin minature
1 gr. Machine screws, 6-32 1/2"
1 gr. Machine nuts, 6-32 1/4"
15--Terminal strips, Jones barrier 5 connector
25--Terminal strips, solder lug type 5 lug
5--Coil forms, 1 1/2" phenolic, 5 pin

WIRE
100 ft. Antenna wire, 300 ohm TV lead-in

100 ft. Fixture wire, 2 cond. plastic 16"
3000 ft. Hook-up wire, #20 solids, tinned
15 lb. Solder, 50/50 rosin core (1 lb. rolls)

MISCELLANEOUS
2 bot. Cement
10 ft. Spaghetti, assorted sizes
1 gal. Cleaning fluid (carbon-tet., etc.)
5 rolls Friction tape, plastic electricians

SHEET METAL SHOP

MACHINES AND EQUIPMENT
1-Anvil, 200 lb.
1-Compressor, air, 30 gal. capacity
1-Brake, 5 foot
1-Drill press, 1/2" chuck
1-Folder, bar, 36"
1-Punch, lever, 1/8", 3/16", and 1/4" punches
1-Rolls, forming 36"
1-Shear, throatless
1-Shear, lever, 5" knife
1-Shear, squaring, 36"
1-Shear, ring and circle
1-Stake plate - 30" x 8"
Stakes, 1 each:

Hollow Mandrel, 40"	Creasing
Double Seaming	Conductor
Beakhorn	Round Head
Hatchet	Square
Candlemold	

1-Spray gun and equipment
1-Unit, oxy-acetylene welding and cutting
1-Welder, spot, 10Kva

TOOLS
6-Awls, scratch
6-Blocks, soldering, asbestos, 4 1/2"
3-Chisels, cold, each size: 1/4", 3/8" and 1/2"
2-(Pr.) Coppers, soldering, 3 lb.
2-(Pr.) Coppers, soldering, 4 lb.
4-Dividers, wing, 8"
1-Drill, electric, portable, 3/8" chuck
1-(Set) Drills, twist, 1/16" to 1/2" by 16ths
1-(Set) Drills, twist, wire gauge, Nos.1-60
2-Files, assorted cuts, grades, and sizes
3-Groovers, hand, each: Nos. 0, 2, and 4 gauges
2-Hacksaw frames, adjustable
4-Hammers, riveting, 14 oz.
2-Furnaces, gas, 2-burner, soldering

1-Grinder, 1/2" H. P., 6" wheels
1-Machine, grooving, 30"
1-Machines, rotary, 1 each--turning, burring, setting down, heading, wiring
1-Press, arbor, 3 ton
2-Hammers, tinners raising, 28 oz.
2-Hammers, setting, 14 oz.
6-Mallets, hickory
6-Pliers, combination, 6" and 8"
2-Pliers, long nose, 6"
2-Pliers, round nose, 6"
4-Pliers, diagonals, 6" and 8"
2-Pliers, end cutting nippers, 12"
6-Punches, prick, 3/8"
1-(Set) Punches, hollow, 1/4" to 1" by 16ths
1-(Set) Punches, solid, Nos. 0 through 8
1-Rivet set, each size: Nos. 0 through 8
4-Rules, folding 8'
2-Rules, circumference, 3'
2-Seamers, hand, 7/8" x 3 1/2"
4-Scrapers, plumbers
2-Screwdrivers, common, each size: 3 1/2", 6", 8"
1-(Set) Screwdrivers, Phillips, Nos. 1, 2, 3, and 4
6-Snips, straight, 3" blades
1-Snips, scroll, right, aviation type
1-Snips, scroll, left, aviation
1-Snips, curved 3 1/2" blades
2-Squares, carpenters, steel
2-Squares, combination, with protractor head
1-Straight edge, steel, 8'
2-Wrenches, crescent, each size: 6", 8", and 10"
1-Wrench, pipe, 12"
1-(Set) Trammel points

GLOSSARY OF SHOP TERMS

assembly area: An area within the school shop, free of machinery and equipment, where the component parts of large instructional projects can be assembled.

auxiliary facilities: Rooms or other facilities in or adjacent to the shop area which are used for special purposes. Examples: toilets, dressing rooms, offices, visual aids room, storage rooms, and rooms or booths for painting, sanding, drying, welding, and the like.

exploratory shop: Shops in which instruction is designed to provide a side variety of practical experiences to youth--usually of junior high school age--for the purpose of determining their interests and aptitudes.

extension training: A term applied to instruction or training provided adult employed workers. This training is designed to develop specific skills and technical knowledge in areas which extend or supplement their daily employment. Instruction may be provided either in a shop or classroom.

evening classes: A type of trade extension class held outside the working day of the class members, usually in the evening.

finishing room: An enclosed area within or adjacent to a shop which is used for spraying or painting projects or materials.

general shop: (See shop, general).

instructional aids: A term generally applied to all types of

objects—exclusive of published materials--which are designed to assist the instructor in teaching more effectively. Examples: projected pictures of all types, models, mock-ups, charts, chalk boards, and the like.

instructional area: As applied to a shop, it is an area within the shop usually equipped with tables, chairs, instructor's demonstration desk, book cases, and other equipment, which the instructor and groups of students may use for study and instruction of technical topics which are incidental to the shop instruction. The instructional area can be incorporated in the planning area.

instructional material: A general term usually applied to all forms of printed materials used in instruction, including textbooks, reference books, trade journals, shop manuals, catalogues, student study guides, blue prints, and the like.

instructor, shop: A term generally used more or less arbitrarily to designate a person who teaches or instructs students primarily in manipulative skills.

live engine: A mounted internal combustion engine in running condition, stripped of all non-essential parts and used for instructional purposes.

materials: Those things from which objects are fabricated and which are used in manufacturing process. Examples: steel bars and sheets, lumber, plastics, paper, paint, and other similar products.

model: A three-dimensional representation of a real object or device which has been altered in such a manner as to clarify the construction or operation of the real object.

mock-up: An unnatural layout or arrangement of the working parts of an electrical, hydraulic, or mechanical assembly (usually mounted on a panel board) which clarifies the interrelationship of the several parts and which can be made to operate upon application of power.

panel, silhouette: A panel board, used for mounting hand tools and small shop equipment, on which the outlines of the mounted objects are painted in a contrasting color so that the absence of an object is easily noticed.

panel, tool: An upright wooden surface used for mounting hand tools and small equipment used in shop instruction.

planning area: An area within the shop, equipped with tables, drawing equipment, reference materials, and the like, which is used by students and instructor for planning and laying out instructional jobs or projects. The planning area can be incorporated in the instructional area.

precision machine: Machines which are designed to perform operations requiring a relatively high degree of accuracy, such as lathes, milling machines, universal grinders, boring bars, and similar machines.

project: A complete object built or constructed by a student or group of students for instruction purposes.

reference material: Any printed matter used in shop or classroom which is used as a source of information related to the trade or occupation taught.

related subjects: Subjects which provide instruction in those

aspects of mathematics, science, hygiene, drawing, economics, law, art, and other subjects as may be applied specifically to the occupation for which a person is being trained.

school plant: The total physical facilities of a school, usually confined to one campus or general area.

safety zone: A zone around a machine or work area, usually outlined with a painted stripe on the floor, outside of which a person is safe from possible injury.

service entrance: A door or entrance large enough to admit a delivery truck.

shop area: The total area of a shop used for instructional purposes, exclusive of classroom, wash room, toilets, and the like.

shop, general: A type of shop usually found in secondary schools, in which more than one trade or unit of trade are taught concurrently. The trades or units are usually closely allied, belonging to the same general "family" of trades.

Shop, "heavy": A term sometimes used to indicate a shop requiring large and heavy items of equipment.

shop, "light": A term used to indicate a shop, such as commercial arts and radio shop, in which little, if any, heavy equipment is required.

shop, unit: A shop, usually found in junior colleges, technical institutes, and other post-high school level institutions, in which a single trade or unit of trade is taught (as contrasted to the general type shop in which several units are taught).

supplies: Those expendable items which are necessary for shop

instruction but which do not necessarily become a part of a job or project. Examples: fuels, lubricants, abrasives, cutting tools, files, small drills, fastening devices, pencils, erasers, and other similar supplies.

trade and industrial education: A term synonymous to industrial vocational education which is now used chiefly in a legal sense.

trade preparatory shops: Shops operated during the school day which are designed to prepare persons for entrance into a trade or industrial occupation.

trade extension: (See extension training.)

unit, instruction: A major subdivision of a course of study devoted to one particular type of work or topic.

unit, shop: (See shop, unit.)

utility machine: A machine for general use in any type of shop work, including shop maintenance. Examples: drill press, grinder.

work station: A location within the shop which has the necessary facilities for one student to work as a part of his daily instruction. Examples of work stations are: individual machines (exclusive of utility machines), work benches, and tool rooms. A shop must have at least as many work situations as there are students enrolled in a given class.